TUOLUMNE – STANISLAUS INTEGRATED REGIONAL WATER MANAGEMENT REGION

PROPOSITION 84 IMPLEMENTATION GRANT PROPOSAL ROUND 2

ATTACHMENT 7 – TECHNICAL JUSTIFICATION OF PROJECT PHYSICAL BENEFITS

Integrated Regional Water Management Program
Applicant: Tuolumne County Resource Conservation District

ATTACHMENT 7 – TECHNICAL JUSTIFICATION OF PROJECT

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Murphys Sanitary District Wastewater Treatment Facility Sprayfield Improvement Project (TS-IRWM Project No. 2)

The Disadvantaged Community of Murphys has a critical wastewater treatment need. Recently, inadequacies in the District's effluent disposal capacity have resulted in: 1) wastewater bypass of disinfection facilities and subsequent discharge of substandard effluent to the District's current effluent reclamation area and 2) the exceedance of minimum freeboard requirements in the District's effluent storage pond. The Wastewater Treatment Facility Sprayfield Project is proposed to prevent similar violations thereby providing benefits to the community and environment. Prevention of surface water contamination provides regional benefits to all communities tributary to the drainage courses that would be impacted by spills from the Wastewater Treatment Facility.

The feasibility of the project was evaluated and it was determined an additional 11.5 Mgal/year of disposal capacity would be provided under average rainfall conditions and 9.3 Mgal/year of disposal capacity would be provided under 100 year rainfall conditions. This additional capacity will ensure violations such as those noted above will cease to occur.

Project Physical Benefits

Water Supply

As noted on page 11 of the attached Preliminary Hydrogeologic Impact Assessment and Effluent Disposal Evaluation Report, the project is estimated to provide 9.3 million gallons of supplemental disposal capacity during heavy precipitation years and 11.5 million gallons of supplemental disposal capacity during average precipitation years.

Summary of Benefit:
The treatment facilities essentially take an unusable toxic material and treat it into a usable, affordable, and necessary resource for nearby agricultural property, Hay Station Ranch. This in turn promotes water conservation and wastewater reuse in order to help achieve long term reduction of potable water use. Ultimately, increases in agricultural water use efficiency combined with the use of recycled water free-up domestic water supply helping meet future water demands and increasing domestic water supply reliability. Additionally, construction of the sprayfields would improve agricultural irrigation efficiencies by allowing Hay Station Ranch irrigation flexibility during wet years. It also promotes water recycling thereby contributing to sustainable water supply and reliability during water shortages. Currently, the Hay Station Ranch vineyard is the only disposal means available to the District.

Recent and Historical Conditions:
Providing supplemental disposal capacity would alleviate the need for the District to require Hay Station Ranch to take more effluent than they desire. Years with heavy precipitation result in 2 adverse conditions for the District: 1) more wastewater effluent to dispose of caused by infiltration and inflow into both the District's sewer system and the Wastewater Treatment Facility ponds, and 2) the ground at Hay Station Ranch being saturated from rainfall and unable to absorb

additional irrigation water. Even in years with better than average precipitation, the District has a need to "push" contractual effluent quantities onto Hay Station Ranch in spite of their desire not to take it. This practice results in inefficient use of irrigation water.

The contractual disposal arrangement between the District and Hay Station Ranch is set to expire in April of 2019, so the District has a need to implement an alternative disposal site in case the contract is not renewed. Additionally, Hay Station Ranch is contractually obligated to take 180 Acre-feet of treated wastewater per year, but the waste discharge requirements authorize the District to deliver up to 514 acre feet per year. In years with average to heavy precipitation, the District has a need to deliver more than the contractual 180 acre-feet. This need for disposal above the contractual amount means the District has a vested interest in fostering and maintaining a good working relationship with the Ranch. Construction of the supplemental disposal system would allow the Ranch to use, explore, and implement more efficient water use practices.

Without Project Conditions:
The District recently received a planning grant to move forward with design of a wastewater treatment facility upgrade. Final implementation of the upgrade is several years into the future. The upgrade would ultimately provide a Title 22 compliant tertiary wastewater treatment plant; however it would not provide the increased disposal capacity currently needed by the District to provide irrigation flexibility to Hay Station Ranch in years with average to heavy precipitation. Without the Sprayfield Project, benefits to the Ranch from the future upgrade include the District's ability to deliver better quality effluent which would result in increased agricultural options for use of the effluent (i.e. spray for frost protection). In this respect, the Sprayfield Project will complement the planned upgrade by promoting irrigation flexibility and agricultural efficiency. Without the Sprayfield Project the District would still need to "push" contractual effluent quantities onto the Ranch under adverse climactic conditions which causes strain in the relationship between the District and the Ranch.

Methodology:
While the physical benefit of improving agricultural efficiency by providing irrigation flexibility is difficult to quantify, the addition of a back-up disposal system would allow the current reclamation area flexibility in ranching practices thereby improving agricultural irrigation efficiencies. This in turn promotes water conservation and wastewater reuse in order to help achieve long term reduction of water use.

Water Quality, Water Treatment

The project is estimated to provide 9.3 million gallons of supplemental disposal capacity during heavy precipitation years and 11.5 million gallons of supplemental disposal capacity during average precipitation years. During the 2010 disposal season, a disposal shortfall of 12.6 million gallons resulted in violations of Waste Discharge Requirements related to land disposal during rain events and

exceedance of reservoir freeboard requirements.

Summary of Benefit:
Construction of the back-up disposal system would increase reliability and the ability to contain the District's effluent. This helps prevent surface water contamination from spilled effluent and potential costs associated with environmental cleanup. The project's implementation would protect beneficial uses of surrounding areas, help the District meet or exceed waste discharge Requirements, and comply with water quality regulations thereby ensuring public health and the environment are protected. Groundwater contamination reduction would be achieved by providing a disposal system that will utilize appropriate agronomic loading rates rather that requiring the current agricultural reclamation area to take more effluent than can be absorbed by the crops.

Recent and Historical Conditions:
Supplemental disposal facilities would address State Water Board concerns associated with water quality. Recently the District received Notices of Violation (attached) related to inadequate disposal capacity. These inadequacies resulted in: 1) effluent bypass of the disinfection system to the storage ponds and subsequent use of substandard effluent for irrigation, 2) land disposal during rain events, and 3) exceedance of the effluent storage pond freeboard requirements. These actions were/are a violation of state regulations and a concern for public health and the environment.

The violations occurred during the 2010-2011 rainy season. As noted in the attached June 9, 2011 Notice of Violation, Water Board staff determined that the 2010-2011 rainy season was correlated to approximately a 2-year return period annual rainfall. This demonstrates the need for supplemental disposal capacity under average to heavy rainfall years. Under very wet year conditions, the District could be in jeopardy of spilling effluent from the treatment facility ponds which subjects the District to potential monetary liability and increased enforcement by the State Water Board.

Without Project Conditions:
The District recently received a planning grant to move forward with design of a wastewater treatment facility upgrade. Final implementation of the upgrade is several years into the future. The upgrade would ultimately provide a Title 22 compliant tertiary wastewater treatment plant; however it would not provide the increased disposal capacity currently needed by the District. Without the project, the District must rely on favorable climactic conditions to maintain compliance with Water Board regulations that pertain to reservoir freeboard, wastewater bypass, effluent disposal prohibitions, and wastewater spills. Benefits from the future upgrade project would include increased water quality. Even if the District's wastewater treatment Facility violated regulations after completion of the upgrade, any treated effluent spilled would meet Title-22 standards which is an improvement from the secondary effluent produced today. Because the Water Board considers even Title-22 compliant effluent as wastewater, the planned

upgrade would still not address State water quality concerns related to reservoir freeboard, wastewater bypass, effluent disposal prohibitions, or wastewater spills.

Methodology:
While physical benefit to water quality has not been quantified by the District the State Water Board's issuance of Notices of Violation related to freeboard and wastewater bypass demonstrate the need for supplemental disposal capacity. Harm to public health and surface waters that can be caused by nuisance wastewater is the method used to determine the physical benefit.

Environ-mental Benefits

The project is expected to protect ecosystems and habitat near the wastewater treatment facility and/or Hay Station Ranch that may exist in and around drainage swales tributary to the area. The benefit to the District would be avoided costs related to removal of pollution or contaminants from soil and/or surface water for the general protection of human health and the environment. Potential clean-up costs would include site assessment, sampling, chemical analysis, excavation, and disposal estimated to cost upwards of several thousand dollars depending on the nature and quantity of the potential spill. Additionally, violations of State regulations have resulted in issuance of Notices of Violation against the District. These Notices of Violation frequently require preparation of work plans and/or technical reports to the Water Board. Depending on the nature of the violation, this would require the use of consultant engineers and can cost upwards of several thousand dollars to complete.

Summary of Benefit:
Construction of the back-up disposal system would provide habitat & waterway protection by preventing failure to completely contain the District's effluent. Any spilled effluent or wastewater bypass of treatment facilities has the potential to harm nearby ecosystems and habitat that may come in contact with flowing wastewater.

Recent and Historical Conditions:
Recently the District received Notices of Violation related to inadequate disposal capacity. These inadequacies resulted in: 1) effluent bypass of the disinfection system to the storage ponds and subsequent use of substandard effluent for irrigation, 2) land disposal during rain events, and 3) exceedance of the effluent storage pond freeboard requirements. These recent conditions bring to light the vulnerability of the District's limited disposal capacity to potential effluent spills.

Without Project Conditions:
The District recently received a planning grant to move forward with design of a Wastewater Treatment Facility upgrade. Final implementation of the upgrade is several years into the future. The upgrade would ultimately provide a Title 22 compliant tertiary wastewater treatment plant; however it would not provide the increased disposal capacity currently needed by the District. Without the project, the District must rely on favorable climactic conditions to maintain compliance with Water Board regulations that pertain to reservoir freeboard, wastewater

bypass, effluent disposal prohibitions, and wastewater spills. Benefits from the future upgrade project would include increased water quality. Even if the District's Wastewater Treatment Facility violated regulations after completion of the upgrade, any treated effluent spilled would meet Title 22 standards which is an improvement from the secondary effluent produced today. Because the Water Board considers even Title 22 compliant effluent as wastewater, the planned upgrade would still not address State water quality concerns related to reservoir freeboard, wastewater bypass, effluent disposal prohibitions, or wastewater spills.

Methodology:
If the project was not implemented a possible wastewater spill could potentially have negative environmental impacts to the surrounding water courses as well as financial implications for the District. Costs associated with site assessment, sampling, chemical analysis, excavation, and disposal of contaminated materials can be estimated by comparing anticipated scope of work items with recent nearby project costs (i.e. the District Engineer's office recently required sampling of soils to determine presence of hazardous materials).

Relationship to other Projects

This project integrates with the reconstruction of Groveland Community Service District's lift station and expanding Calaveras County Water District wastewater pond by working toward the common IRWM objective of improving infrastructure to meet wastewater discharge/disposal requirements for DAC's. Completion of this suite of projects will protect water resources in the T-S IRWM Region from contamination. They further complement each other and the other projects in this proposal on a regional basis by meeting Statewide Priorities of using and reusing water more efficiently and protecting surface and groundwater quality.

Facilities, Policies and Actions

The District acknowledges that implementation of the Sprayfield Project will result in increased ongoing operational costs associated with the new facilities. The project will include installation of electrical and monitoring instrumentation, irrigation pipeline and appurtenances, pumping facilities, and runoff containment all of which will require periodic maintenance. Additionally, the use of sprayfields would require the lease of grazing animals to control weeds for fire prevention. The Regional Water Board will implement new waste discharge requirements and monitoring protocols for the District.

Uncertainties

The project benefits would only be realized under adverse climactic conditions that require additional disposal capacity. In low to average precipitation years, the District cannot provide enough effluent to Hay Station Ranch to meet their irrigation needs. In these dry years, the sprayfields would go unused and no benefit would be achieved. The Sprayfield Project is only needed for average to heavy precipitation years. Since future climactic conditions cannot be determined and it is impossible to guarantee that the stated benefits will be realized. However, as noted in the June 9, 2011 Notice of Violation, Water Board staff determined that the 2010-2011 rainy season was correlated to approximately a 2-year return period annual rainfall for Murphys. As such, it is statistically reasonable to assume the sprayfields will be utilized at least every few years.

Adverse Physical Effects

Adverse physical effects were evaluated in the project's environmental documentation. Impacts from the project can be reduced to less than significant with mitigation implemented during design and construction. Oak trees remaining within the sprayfields after construction may be negatively impacted by sprinkler irrigation. The District will continue to monitor oaks after project implementation and provide mitigation if warranted.

Annual Physical Benefits (Table 9)

Table 9 – Annual Project Physical Benefits

Project Name: Murphys Sanitary District Wastewater Treatment Facility Sprayfield Improvement Project (TS-IRWM Project No. 2)
Type of Benefit Claimed: Water Quality & Water Supply

Measure of Benefit Claimed (Name of Units): Million Gallons per year

Additional Information About this Measure:

(a)	(b)	(c)	(d)
	Physical Benefits		
Years of Project Life	Without Project	With Project	Change Resulting from Project (c) – (b)
2012	0	11.5	11.5
2013	0	11.5	11.5
2014 – 2061	0	11.5	540.5
		TOTAL	**563.5**

Comments: As noted on page 11 of the attached Preliminary Hydrogeologic Impact Assessment and Effluent Disposal Evaluation Report, the project is estimated to provide 9.3 million gallons of supplemental disposal capacity during heavy precipitation years and 11.5 million gallons of supplemental disposal capacity during average precipitation years. The average precipitation year value was used for this table.

Expected physical benefits for environmental protection cannot be reasonably quantified annually. Avoided costs for environmental clean-up could range between a few thousand dollars to tens of thousands of dollars depending on the nature and quantity of a potential effluent spill. Also, annual climactic factors are the main cause for concern related to effluent spills, and the amount of rainfall in any given year cannot be predicted with any accuracy. Similarly, avoided costs of technical reports and/or work plans which may be required to address Water Board Notices of Violation are difficult to reasonably quantify.

Stanislaus National Forest Upper South Fork Stanislaus River Watershed Restoration and Water Quality Enhancement Project (T-S IRWM Project No. 9)

With the Upper South Fork Stanislaus River Watershed Restoration and Water Quality Enhancement Project, the Stanislaus National Forest proposes to restore seven wet meadows with a total area of 130 acres and maintain 40 road culverts that are contributing sediment to aquatic ecosystems and are at risk of failure. Coyote Meadow, Bloomer Lake Meadow, Bluff Meadow, and Groundhog Meadow are meadows which are currently functioning hydrologically – providing benefits such as subsurface water storage, flood attenuation, high water quality, carbon storage, and habitat for sensitive species. However, if left untreated, the headcuts located within these meadows will continue to advance and the functions that the meadows are currently providing will be lost. In addition, the trail through Coyote Meadow is intercepting and diverting a stream channel, resulting in impacts to water quality and to aquatic species. In Leland Gully, Upper Three Meadow and Middle Three Meadow gullies have resulted in lower water tables, loss of riparian vegetation, and loss of desired hydrologic function. Restoration is proposed to restore the hydrologic function of these meadows. Restoration of Leland Gully began in 2010. Maintenance of the road culverts will allow water, sediment, and debris to pass normally through stream systems and will reduce erosion of road surfaces and fill material that is harming water quality and aquatic ecosystems. Benefits of the project will include:

- Water Supply - Protection and improvement of water storage in meadows
- Water Quality – Reduction of sediment from eroding streambanks, roads, and culverts. Protection and enhancement of natural meadow water filtration function.
- Environmental Benefits - Protection and restoration of meadows that have particular habitat values for mule deer, Yosemite toad, and Great Gray Owl.
- Recreation and Public Access – Improved trail conditions on a rerouted trail. Improved hunting opportunities by improving deer fawning conditions.
- Flood Control – Decreased magnitude of flood flows by protecting and restoring stream floodplain connectivity and water storage in meadows.
- Climate change - Protection and increase of carbon storage capacity in meadows.

A detailed discussion of each of these project benefits follows.

Project Physical Benefits

Water Supply

Summary of Benefit:

Project implementation will result in increased water storage in 49 acres of meadow and will protect water storage capacity in 29 acres of meadow. Meadow research conducted in the Sierra Nevada has indicated that meadow restoration projects result in raised water table levels and increased volume of subsurface water storage (Hammersmark et al. 2008, Tague et al. 2008). This is because raised channel beds increase water table elevations and facilitate the sponge-like characteristics of meadow ecosystems, storing water that is released slowly. Incised channels, on the other hand, typically exhibit lower water table elevations and drain water quickly from meadow ecosystems.

Recent and Historical Conditions:

Meadow hydrologic function was assessed in 2010 at Coyote Meadow, Bloomer Lake Meadow, Bluff Meadow, Groundhog Meadow, Middle Three Meadows, and Upper Three Meadows following the Meadow Hydrologic Function Rapid Assessment protocol (Frazier 2010). Coyote, Bloomer Lake, Bluff and Groundhog Meadows are currently functioning hydrologically and are thus providing the water storage benefits described above. However, if these headcuts are not stabilized, the stream channels will continue to incise, by way of gully formation (Tracy Weddle, Hydrologist, Stanislaus National Forest, Summit Ranger District). These four meadows total 81 acres. Of this, approximately 29 acres of meadow are located upstream of existing headcuts and are susceptible to gully formation and subsequent loss of subsurface water storage.

Existing gullies in Upper and Middle Three Meadows have already contributed to lowered water table elevations and subsequent loss of ground water storage. The gully in Middle Three Meadows, a 25 acres meadow, is relatively small (approximately 2-3 feet deep) resulting in slightly less than 0.25 meters of water table drop. The gully in Upper Three Meadows, a 17 acre meadow, is much larger and has resulted in a water table drop of over 0.5 meters. Restoration of these meadows to raise the stream channel bed would result in increased subsurface water storage.

Leland Gully was a very large gully, averaging 5-10 feet deep and 25-35 feet wide. Water table drop was substantial. Project implementation at Leland Gully began in 2010 and has raised the channel bed, increasing subsurface storage of water in this 7 acre meadow. During the winter of 2010/2011 the snowpack was approximately 150% of normal. Monitoring in 2011 showed some channel incision occurred during spring runoff, requiring corrective actions. Work completed in 2011 and 2012 has greatly improved channel stability, preserving the gain in subsurface storage. Monitoring is continuing at this site to ensure success.

Historically, all seven meadows would have had high water tables and would have provided for good subsurface water storage.

Without Project Conditions:
If the proposed project were not implemented, headcuts in Coyote, Bloomer Lake, Bluff, and Groundhog Meadows would continue to advance, resulting in lowered water tables in approximately 29 acres of meadow. Middle and Upper Three Meadows already have lowered water tables and reduced subsurface water storage in 42 acres of meadow. If the project were not implemented at these two sites, the opportunity to increase subsurface water storage by raising the stream channel bed elevation would be lost. There is also the potential for further loss of water storage if channel erosion continues at these sites. Without the project, the water table at Leland Gully would still be low and water storage capacity would not be maximized in the 7 acre meadow.

Methodology:
Existing and potential future losses of subsurface water storage has not been

quantified in the meadows. However, meadow acreage where project activities would protect water storage (29 acres) and enhance water storage (49 acres) was quantified in GIS using ArcMap 10.0.

Water Quality, Water Treatment

Summary of Benefit:
Project implementation will protect and enhance water quality by stabilizing streambanks, increasing the filtration capacity of meadows, eliminating impacts from a trail, and reducing sedimentation from roads.

Research on the Tahoe National Forest has indicated that plant species composition in meadows is largely controlled by depth to the water table (Allen-Diaz 1991). In addition, modeling showed that restoration changed water levels throughout a restoration project area. This resulted in an increased spatial distribution of wet/moist plant species and a decrease in dry species composition (Hammersmark et al. 2010). These wet/moist species have deep roots which are more capable of stabilizing banks and preventing erosion than shallow rooted dry species. This increase in bank stability following restoration leads to a reduction in sediment inputs downstream. In addition to reducing bank erosion and sediment inputs, hydrologically functional meadows also reduce sediment loading by capturing suspended sediment already in streams and storing this sediment in the floodplain. By filtering out this sediment the healthy streamside meadow vegetation can help build stream banks and improve water quality (Aylward and Merrill 2012).

The proposed project is anticipated to maintain the wet/moist native plant species composition and prevent further advancement of headcuts and associated channel erosion in Coyote, Bloomer Lake, Bluff, and Groundhog Meadows (29 acres). The project would also increase the wet/moist species composition and cover leading to improved streambank stability and filtration of suspended sediments in Leland Gully and Upper and Middle Three Meadows (49 acres). An increase in wet/moist vegetation and subsequent increase in bank stability has already been observed at Leland Gully following the work begun in 2010. Bank stability will continue to improve as vegetative cover continues to increase over time at this site. In addition, the stream channel in Coyote Meadow is flowing down the Coyote Meadow trail, causing water quality degradation. A trail re-route would address this issue by moving the trail out of the meadow and returning the stream to its original channel.

Under sized and damaged culverts plug during peak flow, limiting water, sediment and debris passage. Natural peak flow inputs to stream environments are important to maintain sediment regimes, aquatic habitat and life cycles of native species (e.g., breeding timing). Impaired culverts disrupt these components of the natural hydrologic regime, impacting stream ecosystems in the immediate vicinity of road-stream interface and downstream. Water, debris and sediment held upstream from impaired culverts have high potential to flow over the road surface, potentially washing out sections of road. Maintenance of 40 culverts in the Upper South Fork Stanislaus watershed can prevent these deleterious effects to water

quality by reducing the likelihood of culvert plugging.

The South Fork Stanislaus River watershed is the municipal water supply for 80% of water customers in Tuolumne County (USDA 2002, page 71). In addition, over 95% of the Tuolumne Utilities District (TUD) water is supplied through a contract with Pacific Gas & Electric from waters which originate in the Upper South Fork Stanislaus River watershed. Reduction of existing sediment inputs and prevention of future sediment inputs is critical in protecting the quality of this municipal water supply.

Recent and Historical Conditions:
Meadow hydrologic function was assessed in 2010 at Coyote, Bloomer Lake, Bluff, Groundhog, Middle Three and Upper Three Meadows following the Meadow Hydrologic Function Rapid Assessment Protocol (Frazier 2010). These assessments looked at two parameters which affect water quality in the watershed: streambank stability and herbaceous plant community.

Results of these assessments indicated that Coyote, Bloomer Lake, Bluff, and Groundhog Meadows all have stable streambanks throughout most of their lengths, but headcuts within the meadow threaten future stability. Middle Three Meadows has reduced streambank stability, with stable banks comprising 50-75% of the total stream length. Upper Three Meadows has generally poor bank stability, with slightly greater than 50% stability throughout its entire length.

Assessment results also indicated that Coyote, Bloomer Lake, Bluff, and Groundhog Meadows all have herbaceous plant communities that are deep rooted and associated with hydric soils (wet/moist vegetation). Middle Three Meadows overall has good herbaceous species composition. Slightly more than 75% of the meadow is comprised of these wet/moist meadow species. However, along the gullied channel and in two main bare areas this vegetation is lacking. Upper Three Meadows has less than 25% wet/moist herbaceous plant species and approximately 50% bare ground. Both Middle and Upper Three Meadows have been excluded from grazing since the mid-1970's, but only minimal recovery has occurred due to the channel incision and resultant lowering of the water table.

Although the Meadow Hydrologic Function Protocol was not applied to Leland Gully, this meadow had a high percentage of bare ground, a low percentage of wet/moist native plant species, and poor bank stability. Willow cuttings were installed in the project area in 2010 and 2011. Native seed was applied to the site by hand in 2010, 2011, and 2012. Both willow and native seed were harvested within 5 miles of the restoration site in an effort to preserve native plant genetics and in accordance with the USFS native plant material standards. Site monitoring in 2012 indicated herbaceous wet/moist meadow plant species cover has increased and contributed to improved bank stability in this area. Monitoring of vegetation will continue until the site reaches the goal of 90% vegetative cover. Additional seeding and/or willow planting may continue to help achieve this goal.

Historically, all seven meadows would have supported deep rooted wet/moist herbaceous plant species and have high streambank stability. This would have resulted in low rates of sedimentation downstream.
Road inventories completed in 2009 and 2010 using the Motorized Road and Trail Condition Inventory Protocol (Grant et al. 2011) identified culverts that had been plugged, damaged, or otherwise impaired and catalogued road segments with existing erosion features or risk of future erosion. The inventory also found that an estimated 70 cubic yards of road material had eroded from segments of road that were hydrologically connected to waterways, although the amount directly attributable to culvert failure is unknown.

Without Project Conditions:
If the proposed project were not implemented, headcuts in Coyote, Bloomer Lake, Bluff, and Groundhog Meadows would continue to advance, resulting in a reduction in the amount of wet/moist herbaceous vegetation in the meadow. This would also increase the length of unstable streambanks as the gully expands upstream and would reduce the ability of the meadow vegetation to filter out suspended sediments in the streamflow during high flow events. The amount of wet/moist meadow vegetation is already slightly reduced in Middle Three Meadows and substantially in Upper Three Meadows compared to intact meadow ecosystems in this area. Streambanks stability is poor and would continue to contribute sediment to stream channels without project implementation. Implementation of Leland Gully began in 2010, so wet/moist herbaceous vegetation and streambank stability has already improved greatly, however without the project streambank stability would have remained poor and sediment input would have continued to be high. Improvements are expected to continue as vegetation continues to establish in the meadow.

If culverts are not maintained, road erosion will continue to occur and the risk of road washouts will be elevated. Estimates of fill volume above impaired culverts suggest that approximately 800 cubic yards of sediment could enter waterways were all damaged culverts to catastrophically fail. While this extreme scenario is unlikely, it provides a useful upper limit for the potential effect.

Methodology:
Erosion of stream channels and subsequent water quality impacts have not been quantified at the project sites. However, existing and potential future losses of deep rooted wet/moist herbaceous vegetation and loss of streambank stability can be estimated by meadow acreage. Meadow area where the project will protect against loss of water quality is 29 acres (Coyote, Bluff, Bloomer Lake, and Groundhog Meadow acreage upstream of headcuts). Meadow area where water quality benefits will be improved by the project is 49 acres (Leland Gully, Upper and Middle Three Meadows). This acreage was quantified using ArcMap 10.0.

Forty culverts would be maintained in the Upper South Fork Stanislaus watershed. While exact levels of water quality benefits are unknown, potential volume of sediment release was estimated by measuring road fill volume above a sample of

affected culverts.

Environmental Benefits

Summary of Benefit:
Project implementation would lead to the protection of 29 acres of meadow habitat from degradation and improvement of 49 acres of meadow habitat. These habitat benefits would be of particular importance to mule deer, Yosemite toad, and Great Gray Owl.

Local research on the Jawbone deer herd shows that more fawns are born in meadows than any other habitat, although meadows represent less than one percent of the area utilized by mule deer in summer months. Wet meadows meet the requirements of pregnancy and lactation better than any other habitat and receive especially high concentrations of does and fawns (Leopold et al. 1951). Maintaining the wet meadow habitat in Coyote, Bluff, Bloomer Lake, and Groundhog Meadows would protect this deer fawning habitat (29 acres). Improving the conditions of meadow habitat in Leland Gully and Middle and Upper Three Meadows (49 acres) could improve deer fawning habitat.

Yosemite toad is a Region Five Forest Service Sensitive species and a US Fish and Wildlife Service candidate species in accordance with the Endangered Species Act. A three year study conducted in meadows on the Sierra National Forest indicated that Yosemite toad occupancy rates of meadows increased with meadow wetness. This was attributed to toad preference for breeding/rearing habitat associated with wetter meadows (Allen-Diaz et al. 2010). The proposed project would maintain wet meadow conditions in Coyote, Bluff, Bloomer Lake, and Groundhog Meadows (29 acres), as well as increase meadow wetness in Middle and Upper Three Meadows (42 acres). All six of these meadows have occupied Yosemite toad breeding habitat that would be protected and improved. There is no Yosemite toad breeding habitat at Leland Gully. In addition, the trail re-route at Coyote Meadow would move the trail away from an existing breeding pool, reducing the likelihood of trampling and improving fecundity rates in this population.

Great Gray Owl (GGOW) is also a Region Five Forest Service Sensitive species and a State of California threatened species. GGOW in the central Sierra Nevada are genetically unique from more northern and eastern populations and occur at the southernmost extent of the species range. Meadows are their preferred foraging habitat because prey of this large owl species occur in grass-forb covered areas. All meadows proposed for restoration are considered suitable habitat for the GGOW (78 acres). There have been reported sightings of GGOW in the Upper South Forks Stanislaus River watershed. However, none of the sightings have yet been confirmed (Adam Rich, Biologist, Stanislaus National Forest, Summit Ranger District). Protecting and improving meadow ecosystems in the central Sierra Nevada will benefit GGOW by sustaining suitable habitat for population expansion. Since unconfirmed sightings of GGOW in the Upper South Fork Stanislaus Watershed indicate the potential presence in the area, protecting and improving meadow habitats in this project may benefit this sensitive and unique wildlife

species by increasing high quality habitat in the near future.

Recent and Historical Conditions:
Because they had acceptable hydrological functioning based on assessments performed in 2010, Coyote, Bloomer Lake, Bluff, and Groundhog Meadows likely provide suitable wildlife habitat. However, headcuts have been found in each meadow that threatens to degrade habitat suitability of left untreated. Decreased meadow wetness and vegetation cover at Leland Gully and Upper and Middle Three meadows before implementation indicated that habitat quality was reduced for all three species.

Historically, all seven meadows would have supported high quality mule deer fawning and GGOW foraging habitat as well as wet/moist vegetation. Six of the meadows (all except Leland Gully) would have had good Yosemite toad breeding habitat.

Without Project Conditions:
If the proposed project were not implemented, headcuts in Coyote, Bloomer Lake, Bluff, and Groundhog Meadows would continue to advance, resulting in habitat degradation for mule deer fawning and GGOW foraging. Drying of the meadows would likely occur upstream of the headcuts, reducing the suitability for Yosemite toad breeding at these sites. Without project implementation, Leland Gully and Middle and Upper Three Meadows would have continued to have reduced habitat quality for all three species. Restoration initiated at Leland Gully has already provided improvements to deer fawning and GGOW foraging habitat. Continued improvements are anticipated as vegetative recovery continues at this site.

Methodology:
Existing and potential future losses of mule deer fawning habitat, Yosemite toad habitat, and GGOW foraging habitat can be estimated by meadow acreage. Meadow area at risk of loss of these benefits is 29 acres (Coyote, Bluff, Bloomer Lake, and Groundhog Meadow acreage upstream of headcuts). Meadow area with potential for improvement is 49 acres (Leland Gully, Upper and Middle Three Meadows). This acreage was quantified using ArcMap 10.0.

Recreation and Public Access

Summary of Benefit:
The quality of recreational activities can be improved through the proposed meadow restoration projects. One component of Coyote Meadow restoration is to reroute 0.3 miles of trail from running through the meadow to the forest edge of the meadow. This trail provides hiking, equestrian and backpacking access to the Emigrant Wilderness yet the current proximity to the stream channel and wet meadow location frequently results in wet and muddy conditions that discourage travel. Rerouting this trail will provide an improved travel path that will remain dry and provide a more beneficial recreational experience to forest visitors.

The quality of deer hunting is tied to the quality of the deer habitat. . As discussed

above, all meadows proposed for restoration in this project will likely be utilized by mule deer for summer forage and as fawning habitat. By improving and protecting this habitat, reproduction rates of local mule deer populations and genetic diversity may be enhanced. In addition to this contribution to mule deer population health, restoring these important habitats will allow for viable mule deer populations and sustainable hunting opportunities into the future. Stabilizing and improving meadow habitats for mule deer at Coyote, Bluff, Bloomer Lake, and Groundhog Meadow (29 acres) would prevent degradation of existing deer hunting conditions in the area. Improving meadow conditions for deer at Leland Gully and Upper and Middle Three Meadows (49 acres) would improve the hunting conditions in that area. The restoration work that has already begun at Leland Gully will continue to improve deer habitat quality as vegetative recovery continues at this site.

The role of meadow restoration in improving hunting opportunities is further evidenced by support of meadow restoration projects by local advocacy groups. The California Deer Association has contributed funding to the Stanislaus National Forest for meadow restoration projects in the past. In addition, the Mule Deer Foundation has donated countless hours on the forest constructing temporary fences around meadow restoration sites.

Recent and Historical Conditions:
A 2012 field visit to Coyote Meadow by Forest Service staff identified the issue of an intermittent stream channel flowing down the Coyote Meadow trail. Trail widening was occurring due to people and horses trying to avoid the standing water and mud that characterized this portion of the trail. These conditions have led to reduced trail quality for recreational users.

Because they had acceptable hydrological functioning based on assessments performed in 2010, Coyote, Bloomer Lake, Bluff, and Groundhog Meadows likely provide deer habitat suitable for maintaining desirable hunting conditions. However, headcuts have been found in each meadow that threatens to degrade habitat suitability and hunting opportunities if left untreated. Decreased meadow wetness and vegetation cover at Leland Gully and Upper and Middle Three meadows before implementation indicated that habitat quality was reduced for deer foraging and fawning.

Without Project Conditions:
Without project implementation, the stream channel at Coyote Meadow would continue to flow down the Coyote Meadow trail, resulting in continued degradation of trail conditions, including deepening and widening of the trail. This would continue to worsen the trail experience for recreational users and might diminish the number of trail users.

If the proposed project were not implemented then the quality of mule deer habitat would degrade at Coyote, Bloomer Lake, Bluff, and Groundhog Meadows as the headcuts continue to advance and degrade summer forage and fawning

habitat. This could reduce the quality of mule deer hunting in the area and contribute to weakened local mule deer population health. The quality of deer fawning habitat was already degraded at Leland Gully and Upper and Middle Three Meadows. Not implementing the project would mean that potential improvements to this deer habitat and the subsequent improvements to the quality of deer hunting would not be realized.

Methodology:
Benefits of the Coyote Meadow trail reroute can be quantified by the length of trail reroute. This is estimated to be 1420 feet of trail reroute.

Existing and potential future losses of mule deer hunting quality can be estimated by meadow acreage with improved or protected deer habitat. Meadow area at risk of loss of quality deer habitat is 29 acres (Coyote, Bluff, Bloomer Lake, and Groundhog Meadow acreage upstream of headcuts). Meadow area with potential for improvement is 49 acres (Leland Gully and Upper and Middle Three Meadows). This acreage was quantified using ArcMap 10.0.

Flood Control

Summary of Benefit:
Research following implementation of meadow restoration projects has indicated a decreased magnitude of flood peaks (Hammersmark et al. 2008, Ohara et al. 2012). This can be attributed to the fact that, following restoration, water is transferred from the channel to the floodplain and temporarily stored. This benefit is reduced in degraded meadows where the stream channels are disconnected from their floodplains and water remains confined. The consequences of reduced flood attenuation capacity in the watershed include increased channel erosion during high flows and increased damage to infrastructure, such as culvert washouts and road surface erosion.

Implementation of the proposed project in meadows with good (>75%) floodplain connectivity (Coyote, Bloomer Lake, and Groundhog Meadows, 26 acres) would prevent degradation of floodplain connectivity and existing flood attenuation capacity. Implementation of the proposed project in meadows with some (50-75%) floodplain connectivity (Bluff and Middle Three Meadows, 28 acres) would maintain existing floodplain connectivity and have the potential to improve this connectivity. This would result in improved flood attenuation capacity. Implementation of the proposed project in meadows with poor (<50%) floodplain connectivity (Upper Three Meadows, Leland Gully, 24 acres) would improve floodplain connectivity and result in improved flood attenuation capacity.

Recent and Historical Conditions:
Meadow hydrologic function was assessed in 2010 at Coyote, Bloomer Lake, Bluff, Groundhog, Middle Three, and Upper Three Meadows following the Meadow Hydrologic Function Rapid Assessment Protocol (Frazier 2010). Results of these assessments indicated that stream channels within Coyote, Bloomer Lake, and Groundhog Meadows have access to their floodplains throughout most of the

stream length (>75%). Stream channels in Bluff and Middle Three Meadows have slightly reduced access to their floodplains (50-75% of channel length). The stream channel in Upper Three Meadows has access to its floodplain in less than 50% of its length. Although the Meadow Hydrologic Function Protocol was not applied to Leland Gully, pre-restoration conditions would have indicated a loss of floodplain connectivity throughout most of its length since gully depth averaged 5-10 feet. Historically, all seven meadows would have had high floodplain connectivity and would have provided flood attenuation benefits.

Without Project Conditions:
If the proposed projects were not implemented, headcuts in Coyote, Bloomer Lake, and Groundhog Meadows would continue to advance, resulting in reduced floodplain connectivity and flood attenuation capacity in approximately 26 acres of meadow. Bluff and Middle Three Meadows already have some reduction in floodplain connectivity and flood attenuation capacity. This would further reduce as the headcut in Bluff Meadow advances and as the stream channel in Middle Three Meadows continues to incise (28 acres). If the project were not implemented, the opportunity to improve floodplain connectivity and flood attenuation capacity in Leland Gully and Upper Three Meadows would be lost (24 acres). There would also be potential for further loss if channel erosion continued at these sites.

Methodology:
Flood attenuation capacity (flood water storage) has not been quantified for this project. However, meadows proposed for restoration have been assessed for floodplain connectivity. Meadow acreage at risk of loss of floodplain connectivity (26 acres), with some potential for improvement (28 acres), with large potential for improvement (24 acres) was quantified using ArcMap 10.0.

Other-Climate Change

Summary of Benefit:
Research conducted by the University of Wyoming and UC Davis Extension on the Stanislaus National Forest found that soils of more moist properly functioning meadows have at least twice the carbon storage of non-functioning or drier meadows (Norton et al. 2011). In addition, research in the Feather River watershed found that restored meadows contained twice as much soil carbon as degraded meadows, on average approximately 40 tonnes more carbon per acre. Virtually all of the additional carbon storage in wet meadows compared to dry meadows is stored the soil, protecting it from loss via grazing, wildfire, etc. (Feather River Coordinated Resource Management 2010).
All meadows of this proposed project have this intrinsic capacity to sequester and store carbon. Stabilization of headcuts at Coyote, Bloomer Lake, Bluff, and Groundhog Meadows (29 acres at risk) would prevent the drying of these meadows and the loss of 1,160 tonnes of carbon storage. Restoration of Leland Gully and Upper and Middle Three Meadows (49 acres degraded) could result in an additional storage of 1,680 tonnes of carbon. Carbon sequestration is essential in stabilizing current and reducing future atmospheric levels of CO_2 and mitigating

impacts of climate change.

Recent and Historical Conditions:
Meadow hydrologic function was assessed in 2010 at Coyote, Bloomer Lake, Bluff, Groundhog, Middle Three, and Upper Three Meadows following the Meadow Hydrologic Function Rapid Assessment Protocol (Frazier 2010). Results of these assessments indicated that Coyote, Bloomer Lake, Bluff, and Groundhog Meadows are currently properly functioning hydrologically and thus have natural carbon storage levels. Middle Three Meadows is borderline functioning/functioning-at-risk. Upper Three Meadows is non-functioning hydrologically and has thus lost substantial carbon storage capacity. Although the Meadow Hydrologic Function Protocol was not applied to Leland Gully, pre-restoration it was non-functional hydrologically and would have had reduced carbon storage capacity. Historically, all seven meadows would have been properly functioning.

Without Project Conditions:
If the proposed project were not implemented, approximately 29 acres within Coyote, Bloomer Lake, Bluff, and Groundhog Meadows would dry and release CO_2 into the atmosphere. Middle Three Meadows (25 acres) could continue to degrade and additional CO_2 would be released into the atmosphere as the meadow moves towards non-functioning. Upper Three Meadows (17 acres) would not likely release more CO_2, as it is already non-functional. However, the opportunity to increase carbon storage by re-wetting the meadow would be lost. Restoration efforts already implemented at Leland Gully (7 acres) have greatly improved ecosystem structure, but without project implementation these gains would not have been realized.

Methodology:
Although Norton et al. (2011) collected soil carbon data on the Stanislaus National Forest, none of the meadows proposed for restoration were his sample sites. Therefore, carbon storage at the proposed restoration sites has not been quantified. However, since Norton found that soils in properly functioning meadows have at least twice the carbon storage as non-functioning meadows, it is assumed that continued degradation of the properly functioning meadows would result in loss of about half their current carbon storage. It is also assumed that restoring non-functional meadows could double the existing carbon storage.

Results from the Feather River watershed supported Norton's findings of twice the carbon storage in restored meadows as found in degraded meadows (Feather River Coordinated Resource Management 2010). They found the average increase in carbon storage was 40 tonnes per acre. Applying that figure to the proposed restoration site, stabilization of headcuts at Coyote, Bluff, Bloomer Lake, and Groundhog Meadows would result in preventing the potential loss of 1,160 tonnes of carbon (29 acres x 40 tonnes/acre). Proposed work in Middle and Upper Three Meadows could result in an additional storage of 1,680 tonnes of carbon (42 acres x 40 tonnes/acre). The restoration work completed in Leland Gully likely stored an additional 280 tonnes of carbon (7 acres x 40 tonnes/acre).

Relationship to other Projects

The six meadows proposed for restoration, the meadow restored in 2010 and culverts proposed for maintenance are located within the Upper South Fork Stanislaus River watershed. By treating multiple meadows and maintaining road system culverts within one area, the benefits of restoration are compounded. By treating a larger acreage we are more likely to see the beneficial improvements to water supply, water quality, deer fawning habitat, Yosemite toad habitat, Great Gray Owl habitat, quality of recreation experiences, flood control, and resilience to the effects of climate change.

Downstream water quality benefits realized by this project will be complementary to benefits from the Phoenix Lake Preservation and Restoration Project and the Small Parcel Storm Water Pollution Prevention and Landowner Stewardship Program. Phoenix Lake is supplied by waters diverted from the South Fork Stanislaus River. The improvements to the supply of water that Phoenix Lake receives that will result from this project will assist in reaching the goal of providing reliable and safe water supply to municipal water users.

Facilities, Policies and Actions

No further facilities, policies, or actions beyond what is described in the work plan will be required to obtain full benefits from this project.

Once vegetative recovery has occurred (typically 1-3 years following implementation), meadow restoration projects are self-maintaining. The deep root structure of the wet/moist riparian vegetation provides for high bank stability which can withstand high flows. Evidence of this self-maintaining nature has been observed through monitoring efforts at Lower Three Meadows on the Stanislaus National Forest. This site is located just downstream of Middle Three Meadows. Meadow restoration occurred in 1976 and involved rebuilding a deeply incised stream channel. The Lower Three Meadows water table was raised and the vegetation recovered. Meadow hydrologic function at this site was assessed in 2010 following the Meadow Hydrologic Function Rapid Assessment Protocol (Frazier 2010). This meadow was found to be properly functioning.

Uncertainties

The benefits from project implementation at Coyote, Bloomer Lake, Bluff, and Groundhog meadows all come in the form of protection of resource values that will be lost if the meadows are untreated. However we lack sufficient data to put a timetable on the expected loss of these functions. The rate of loss may be highly variable based on climactic conditions and the progression of vegetation changes in the meadows. The Stanislaus National Forest has recently implemented monitoring of the rate of headcut movement in several meadows which in the future will help us to predict how quickly values such as water storage, water quality benefits, wildlife habitat, and carbon storage will be lost. We also lack sufficient data on the frequency of culvert failure and on the proportional contribution of malfunctioning culverts to ongoing road erosion to fully quantify those benefits.

There are additional difficulties in calculating the benefits of meadow restoration quantitatively. Years of pre-implementation data collection is necessary to assemble accurate background information for comparison with post-implementation data for quantification of benefits. Such information is unfortunately not available for the meadows in this proposal. Therefore, we rely on research at other

restoration sites in the Sierras to better understand the benefits and can for the most part only calculate acreages where we anticipate seeing these benefits.

However, the Stanislaus National Forest has extensive meadow restoration experience, with some projects dating back as far as the mid-1970's. Although not quantified, photo documentation can be used to see that benefits described in research are similar to what we have seen on the forest. The following photos were taken at Faust Cabin Meadow on the Stanislaus National Forest. The meadow restoration project was implemented in fall 2002 at this site. These photos show the following benefits: the water table was raised, increasing subsurface storage; improved moist/wet herbaceous vegetation and streambank stability resulted in improved water quality; improved habitat for deer (there are no Yosemite toad populations at this site); improved floodplain connectivity, leading to increased flood attenuation capacity; and more moist meadow conditions, leading to an increase in soil carbon storage (carbon sequestration), which is important in mitigating impacts of climate change.

Figure 1 - Upstream view of Faust Cabin Meadow prior to treatment in late 2002.

Figure 2 - Upstream view of Faust Cabin Meadow in 2005 after restoration.

Figure 3 - Downstream view of Faust Cabin Meadow prior to treatment in late 2002.

Figure 4 - Downstream view of Faust Cabin Meadow in 2005 after restoration (note two trees about 3 feet apart on left bank as a reference to Figure 3).

Adverse Physical Effects

Fall and early winter rainfall, as well as spring snowmelt, may cause sediment inputs to streams during the first year or two following implementation as the project areas would not yet have full vegetative cover. Sediment inputs are expected to be minor and short term, as seeding, planting, and mulching would all be considered in project design to minimize bare ground. However, sediment inputs are expected to be reduced in the long term at all treatment sites because headcuts would no longer continue to advance, the trail at Coyote Meadow would be re-located and no longer intercepting the stream channel, and vegetative cover would improve in the degraded meadows.

Annual Physical Benefits (Table 9)

Table 9 – Annual Project Physical Benefits

Project Name: Stanislaus National Forest Upper South Fork Stanislaus River Watershed Restoration and Water Quality Enhancement Project (T-S IRWM Project No. 9)

Type of Benefit Claimed: Water Supply

Measure of Benefit Claimed (Name of Units): Acres

Additional Information About this Measure: Acres of meadow where subsurface water storage would be gained or protected through project implementation

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2010	0	7	7
2015	0	18	18
2016	0	36	36
2017	0	78	78
		TOTAL	**78**

Comments: Leland Gully – 7 acres, implemented in 2010; Coyote Meadow – 11 of 40 acres at risk, implement in 2015; Bloomer Lake Meadow – 8 of 14 acres at risk, implement in 2016; Bluff Meadow – 3 of 15 acres at risk, implement in 2016; Groundhog Meadow – 7 of 12 acres at risk, implement in 2016; Middle Three Meadows – 25 acres degraded, implement in 2017; Upper Three Meadows – 17 acres degraded, implement in 2017. Total of 29 acres of meadow protected from loss in subsurface water storage (Coyote, Bluff, Bloomer Lake, and Groundhog Meadows), and 49 acres with improved subsurface water storage (Upper and Middle Three Meadows, Leland Gully). Project is expected to be self-sustaining with no anticipated end to operational life.

Table 9 – Annual Project Physical Benefits

Project Name: Stanislaus National Forest Upper South Fork Stanislaus River Watershed Restoration and Water Quality Enhancement Project (T-S IRWM Project No. 9)

Type of Benefit Claimed: Water Quality (sedimentation)

Measure of Benefit Claimed (Name of Units): Acres

Additional Information About this Measure: Acres of meadow where streambank stability and wet/moist herbaceous vegetation would be protected or improved through project implementation

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2010	0	7	7
2015	0	18	18
2016	0	36	36
2017	0	78	78
		TOTAL	**78**

Comments: Leland Gully – 7 acres, implemented in 2010; Coyote Meadow – 11 of 40 acres at risk, implement in 2015; Bloomer Lake Meadow – 8 of 14 acres at risk, implement in 2016; Bluff Meadow – 3 of 15 acres at risk, implement in 2016; Groundhog Meadow – 7 of 12 acres at risk, implement in 2016; Middle Three Meadows – 25 acres degraded, implement in 2017; Upper Three Meadows – 17 acres degraded, implement in 2017. Total of 29 acres of meadow protected from loss of streambank stability and wet/moist herbaceous plant species (Coyote, Bluff, Bloomer Lake, and Groundhog Meadows), and 49 acres with improved streambank stability and wet/moist herbaceous plant species (Upper and Middle Three Meadows, Leland Gully). Project is expected to be self-sustaining with no anticipated end to operational life.

Table 9 – Annual Project Physical Benefits

Project Name: Stanislaus National Forest Upper South Fork Stanislaus River Watershed Restoration and Water Quality Enhancement Project (T-S IRWM Project No. 9)

Type of Benefit Claimed: Flood Control

Measure of Benefit Claimed (Name of Units): Acres

Additional Information About this Measure: Acres of meadow where flood attenuation capacity (flood water storage) would be gained or protected through project implementation

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2010	0	7	7
2015	0	18	18
2016	0	36	36
2017	0	78	78
		TOTAL	**78**

Comments: Leland Gully – 7 acres, implemented in 2010; Coyote Meadow – 11 of 40 acres at risk, implement in 2015; Bloomer Lake Meadow – 8 of 14 acres at risk, implement in 2016; Bluff Meadow – 3 of 15 acres at risk, implement in 2016; Groundhog Meadow – 7 of 12 acres at risk, implement in 2016; Middle Three Meadows – 25 acres degraded, implement in 2017; Upper Three Meadows – 17 acres degraded, implement in 2017. Total of 26 acres of meadow protected from loss of flood attenuation capacity (Coyote, Bluff, Bloomer Lake, and Groundhog Meadows), 28 acres with some potential for improvement in flood attenuation capacity (Bluff and Middle Three Meadows) and 24 acres with large potential improvement in flood attenuation capacity (Upper Three Meadows, Leland Gully). Project is expected to be self-sustaining with no anticipated end to operational life.

Table 9 – Annual Project Physical Benefits

Project Name: Stanislaus National Forest Upper South Fork Stanislaus River Watershed Restoration and Water Quality Enhancement Project (T-S IRWM Project No. 9)

Type of Benefit Claimed: Wildlife Habitat (deer fawning, great gray owl foraging, and Yosemite toad breeding habitat)

Measure of Benefit Claimed (Name of Units): Acres

Additional Information About this Measure: Acres of meadow where deer fawning, Yosemite toad breeding, and great gray owl foraging habitat would be protected or improved through project implementation

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2010	0	7	7
2015	0	18	18
2016	0	36	36
2017	0	78	78
		TOTAL	**78**

Comments: Leland Gully – 7 acres, implemented in 2010 (no Yosemite toad habitat at this location); Coyote Meadow – 11 of 40 acres at risk, implement in 2015; Bloomer Lake Meadow – 8 of 14 acres at risk, implement in 2016; Bluff Meadow – 3 of 15 acres at risk, implement in 2016; Groundhog Meadow – 7 of 12 acres at risk, implement in 2016; Middle Three Meadows – 25 acres degraded, implement in 2017; Upper Three Meadows – 17 acres degraded, implement in 2017. Total of 29 acres of meadow protected from loss of wildlife habitat (Coyote, Bluff, Bloomer Lake, and Groundhog Meadows), and 49 acres with improved wildlife habitat (Upper and Middle Three Meadows, Leland Gully). Project is expected to be self-sustaining with no anticipated end to operational life.

Table 9 – Annual Project Physical Benefits

Project Name: Stanislaus National Forest Upper South Fork Stanislaus River Watershed Restoration and Water Quality Enhancement Project (T-S IRWM Project No. 9)

Type of Benefit Claimed: Climate Change-Carbon Storage

Measure of Benefit Claimed (Name of Units): Tonnes of carbon stored in the soil

Additional Information About this Measure: Tonnes of soil carbon storage protected or increased through project implementation

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2010	0	280	280
2015	0	720	720
2016	0	1440	1440
2017	0	3120	3120
		TOTAL	**3120**

Comments: Research indicated average increase of 40 tonnes soil carbon storage per acre of meadow restoration. Leland Gully – 7 acres, implemented in 2010; Coyote Meadow – 11 of 40 acres at risk, implement in 2015; Bloomer Lake Meadow – 8 of 14 acres at risk, implement in 2016; Bluff Meadow – 3 of 15 acres at risk, implement in 2016; Groundhog Meadow – 7 of 12 acres at risk, implement in 2016; Middle Three Meadows – 25 acres degraded, implement in 2017; Upper Three Meadows – 17 acres degraded, implement in 2017. Total of 29 acres of meadow protected from loss of approximately 40 tonnes per acre of soil carbon storage (Coyote, Bluff, Bloomer Lake, and Groundhog Meadows upstream of headcuts), and 49 acres with increase of approximately 40 tonnes per acre of soil carbon storage (Upper and Middle Three Meadows, Leland Gully). Project is expected to be self-sustaining with no anticipated end to operational life.

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Tuolumne County Resource Conservation District Small Parcel Storm Water Pollution Prevention and Landowner Stewardship Program (T-S IRWM Project No. 16)

The purpose of the proposed Small Parcel Storm Water Pollution Prevention and Landowner Stewardship Program is to develop a project that will achieve immediate and lasting reductions in nutrient, sediment and pathogen pollution to surface and ground waters in the Tuolumne and Stanislaus River watersheds through implementation of BMP's on small acreage livestock facilities in Tuolumne County.

Project Physical Benefits

Water Quality, Water Treatment

Summary of Benefit:
This project is designed to resolve site-specific nutrient, sediment, and pathogen discharges into the Stanislaus and Tuolumne River watersheds from small privately owned parcels. The proposed project utilizes an incentives based approach to achieve the cultural change needed to voluntarily adopt management measures that improve the healthy functioning of watershed. The objectives of the proposed project are: to increase the knowledge base and behaviors of small acreage landowners in Tuolumne County and to implement cost-efficient Best Management Practices (BMP's) that result in direct reductions of turbidity, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), nutrients and bacteriological pathogens from storm water flows into the Tuolumne and Stanislaus Rivers. Water quality benefits will be achieved through educational outreach and implementation projects.

While the primary justification for the project is surface water quality enhancement and protection, nitrate contamination can also compromise shallow groundwater aquifers in the project area. The project will protect groundwater by reducing nitrate leaching by reducing the exposure of manure to rainfall. This benefit is an important link in promoting social change, as many owners of livestock facilities in these areas are also owners of private drinking water wells.

Secondary benefits include those related to water supply treatment operations, maintenance and decreases in localized flooding, and habitat improvement for special status fish and wildlife species. With decreased concentrations of sediments in surface water sources, there may be potential decreased costs of ongoing maintenance and filter replacement for the local domestic and DAC water supply infrastructure associated with Phoenix Lake.

Additionally, TCRCD demonstration sites and educational outreach will improve local flood management through installation of site-specific stormwater control and treatment improvements. Localized installation of BMP's such as filter strips, french drains and others on small acreage parcels have been proven to directly reduce stormwater flows into adjacent waterways and provide runoff treatment and infiltration areas.

Finally, benefits related to surface water quality improvement may also include habitat improvement for regionally important listed and special status species such as California red-legged frog, foothill yellow-legged frog, western spadefoot toad, various raptors such as osprey and Coopers hawk, and riparian mammals such as ringtail. The riparian habitats adjacent to the 5 project sites where BMPs will be implemented will benefit from the practices that will help reduce nutrient, sediment, and pathogen levels.

Recent and Historical Conditions:
Four creeks within the IRWM Region have been listed on the USEPA CWA Section 303(d) list of "Impaired Waterbodies": Sullivan Creek, Curtis Creek, Woods Creek, and Littlejohns Creek. Each has *E coli* listed as the pollutant, with the sources unidentified. TDML's have not been finalized for these creeks. Additionally, Hetch Hetchy, New Melones, Tulloch, and Don Pedro Reservoirs have also been listed, with the primary pollutant identified as mercury. Potential sources are identified as "resource extraction" The lower Stanislaus and Tuolumne Rivers are also listed with numerous pollutants identified.

In addition, the Tuolumne County Foothill Watershed Assessment identified runoff from unvegetated portions of properties, driveways, corrals, and sites under development as contributors of sediment and bacteriological pathogens to the local and regional stream systems.

The Tuolumne County Resource Conservation District, TCRCD, has an established volunteer citizen water quality monitoring program; Stream Team. The program currently monitors twenty six sites in Tuolumne County in the Stanislaus and Tuolumne river watersheds. The sites are monitored monthly for temperature, pH, electrical conductivity, dissolved oxygen, total coliform, and *E. coli*. Our current monitoring reports will be used to show recent and historical conditions as it relates to our projects water quality benefits.

Without Project Conditions:
Conservatively estimated there are approximately 15,000 properties that have the potential to commercially or privately board livestock in the project region, none of which have been reached with technical assistance to ensure their practices and facility infrastructure are protective of water quality. Many are not even aware that they need assistance, as they are allowing erosion and manure to run off their properties into local waterways but are not aware that it is a problem. By offering this program to the livestock community, they increase their awareness about the impacts their property has in the watershed, and are assisted through the process of planning and implementing solutions. Without the project, the knowledge base and related behaviors will remain the same and as such, local small parcel landowners will continue to manage their properties with minimal awareness of the impacts top surface water quality.

Methodology:

The method that the TCRCD plans to use several methods to quantify the physical benefits of our project to water quality within the TS IRWM Region. Our objectives for the BMPs at our Implementation Sites are to reduce the exposure of 80% of the manure and 50% of the highly erodible soil, and to reduce potential loads by 30%. We propose to measure pollutant reduction on the 5 project sites using the same approach as the Santa Cruz and Monterey County Livestock and Land program as follows:

We will apply load reduction calculations to every project site. To do this we will measure the change in the vulnerability of pollution sources before and after project. Quantifying the change in exposure to rainfall (which is the primary transport mechanism to surface water and groundwater) relies on measuring the aerial extent that manure and sediment are protected from rainfall before and after project implementation. This change will be documented for each of the project sites and be reported as pollutant vulnerability reduction, PVR. We define PVR as follows:

PVR = m (V1-V2)
where
V1 = the volume of manure, soiled straw and sediment exposed to the rain before the project
V2 = the volume of manure, soiled straw and sediment exposed to the rain after the project, and
m = the concentration of each nutrient (N or P) or bacteria in samples of manure, soiled straw and sediment.

Concentration data will be measured from a set of representative samples or estimated based on data in scientific literature. PVR will be expressed as the total mass of each nutrient whose transport potential has been effectively eliminated or dramatically reduced. While this approach does not evaluate the delivery ratio to streams of each polluting constituent, it provides an estimate of the relative efficacy of different projects, and quantifies the potential reduction in pollutant loads if that delivery ratio were 100%. A high delivery ratio (though less than 100%) is likely during cold winter months where microbial degradation of nutrients is minimized and rainfall rates are high.

Reductions in pollution load from BMP sites will also be estimated using data collected from past, present and future TCRCD Stream Team monitoring. Quantitative data will be entered into an excel or access database and submitted to the State in CEDEN format as required in the Grant Agreement.

Additionally, TCRCD will complete a “predictive analysis” worksheet for each demonstration site and technical assistance site. The worksheet was developed for Ecology Action Livestock and Land Program by Fall Creek Engineering . The predictive analysis is designed to be a user-friendly method to document and calculate the estimated effectiveness of best management practices. Manure management, exclusionary fencing, pasture management, drainage controls, and

other equestrian BMPs can be implemented to reduce sediment, nutrients, pathogens, and other potential contamination of nearby waterways. This model also allows different runoff treatment options to be selected and analyzed to predict how they will reduce the impacts from equestrian facilities. The treatment BMPs include bioretention swales, filter strips, and vegetated swales. The model uses site specific information to compute annual loads for the amount of manure produced, as well as the primary constituents of concern, nutrients, pathogens, and sediment.

The annual loading of contaminants is calculated first using existing and proposed site conditions to quantify the sediment, pathogen, and nutrient generation at the site. Then, management practices are taken into consideration, applying removal efficiency from published studies to predict the effectiveness of best management practices at the respective site. (FALL CREEK ENGINEERING, INC (2009) Equestrian Facility Best Management Practices, Predictive Analysis. User Guide *For* Manure and Erosion Pollution Prevention Program. Ecology Action, Santa Cruz, California, January 2009, in Appendix 3-B (Att3_IG2_TuolStan_WorkPlan_3of5).

Finally, this project expects to see the physical benefits manifested through behavioral changes of the landowners. While increasing awareness may be one factor in behavior change that alone may not achieve the long-term outcomes truly desired by our program. Our outcomes must also be related to changing livestock owner behavior. TCRCD will utilize the Community-Based Social Marketing methods used by the Monterey and Santa Cruz RCD's Livestock and Land Program to 1) increase the level of awareness; 2) identify the barriers and benefits to both the current behaviors and the desired behaviors; 3) influence the barriers and benefits such that the desired behavior is the preferred choice; 4) gain commitment to change behaviors; and 5) support desired behaviors with prompts and social norms.

Community-Based Social Marketing research shows that people "do what makes sense". People will choose the behavior that has the fewest barriers and the most benefits. It is our job to understand and influence all of these factors so that managing livestock facilities in a way that is protective of water quality *is* "what makes sense".

TCRCD will also conduct follow-up surveys of all Technical Training participants and Implementation Site owners to evaluate the effectiveness of the program. TCRCD plans to also use photo documentation of project sites and adjacent riparian habitats to monitor the environmental benefits achieved by implementation of BMPs.

Relationship to other Projects

The Tuolumne Utilities District Phoenix Lake Reservoir project provides increased storage capacity in the primary water supply reservoir for our region and will benefits from the physical water quality benefits of the Tuolumne County Conservation District's project. The TCRCD project will provide landowner

education and on-the-ground storm water control and surface water quality enhancements for small acreage parcels within the upper Phoenix Lake watershed and others. In addition the water supply benefits the Amador Tuolumne Action Agency's conservation program will provide through increased water conservation will benefit many of the users of the water focused specifically on DAC's within the region, which include from Phoenix Lake. The Tuolumne River Trust's conservation program similarly focuses on end-users of the municipal water supply from the lake. Finally, the Stanislaus National Forest's meadow restoration will improve surface water quantity and quality providing physical benefits to the South Fork Stanislaus River which provides water to Lyons Reservoir and Phoenix Lake.

Facilities, Policies and Actions

The project proposed by the TCRCD will include six actions that will obtain the physical benefits described:

1. Establishment of a local library of resources and reference materials from other successful similar programs from throughout the United States;
2. An Education and Outreach program that will include locally relevant materials that will be used for ongoing technical assistance to landowners;
3. Five Public Workshops that will include topics such as managing mud, manure, and runoff; design and installation of BMP's; water quality and livestock owner responsibility; reducing erosion; pasture and paddock management; selecting appropriate plants; and keeping pastures green;
4. Technical assistance to landowners where a TCRCD Technical Advisor would visit sites to assess and prioritize needed improvements with property owners;
5. A cost share assistance program for small parcel owners that do not qualify for NRCS programs; and,
6. Implementation and Construction of appropriate BMP's at a minimum of five priority sites.

The work tasks in this program are also designed to address all five critical elements of Community-Based Social Marketing in order to change livestock owner's behavior toward more protective practices:

1. Work tasks designed to <u>increase awareness</u> within the livestock community include: Technical Assistance Trainings, Community and Leadership Outreach, program presence in feed stores and on the internet, and tours of Implementation Sites.

2. Work tasks designed to <u>identify barriers and benefits</u> to behaviors that both are and are not protective of water quality include: technical assistance trainings provide a forum for interactive discussions with participants, surveys at trainings, outreach provides an opportunity for livestock owners to air concerns and challenges, and the implementation site program includes opportunities for applicants identify challenges and report on current behavior, as well as involving site tours with TAC members to gather needed data to identify barriers and benefits.

3. Work tasks designed to <u>influence the barriers and benefits</u> to both behaviors are outlined below. The Monterey and Santa Cruz RCD's program experience, and related programs from all over the country, have already gathered a significant amount of information about this topic. As noted above in #2, TCRCD will continue to gather information to ensure we are current and highly effective in our programming. This past experience of others has informed our program design in terms of what information we deliver, how we deliver it, and what incentives we offer to our participants.

a. Increasing the barriers to polluting behaviors: While this program is non regulatory, the program does increase the awareness among livestock owners of the regulatory implications and the context of water quality regulations. The perceived threat of inspection and enforcement is a barrier to polluting behavior. Additionally, due to its voluntary and collaborative nature, the program generates a social norm among livestock facility owners that it is not OK to be a polluter, which is also a barrier to polluting behavior. Finally, the program will document for cooperators the operational costs and challenges of problems associated with water quality impairment, such as flooded stables, damaged roads, and gully erosion.

b. Decreasing the barriers to water quality protective behaviors: This program reduces the real barrier of lack of skills and knowledge about water quality impacts and solutions via the site-planning component of the technical trainings. It additionally facilitates the step of applying that general knowledge to the complexities of each property via the technical trainings and access to TAC members who can conduct site tours upon request as needed. This program reduces the perceived and real barriers related to the cost of implementing improvements on site by cost sharing for improvements on Implementation Sites and demonstrating to the community the specific and real costs and benefits associated with improvements.

c. Increasing the benefit of water quality protective behaviors: The project creates a social norm, which provides positive experiences for participating livestock to adopt water quality protective behaviors. This project illustrates the multiple benefits of implementing improvements, which can include improved horse health, improved neighbor relations, increased ease of property management, and increased pride of ownership which further encourages behavior change.

4. The project work tasks designed to gain commitment to change behaviors include: signed contracts with implementation site owners to maintain improvements and allow access into the future, and signed pledge requests from exiting technical training participants to complete a written site plan and implement at least one BMP on their property past the training.

5. The project work tasks designed to support desired behaviors with prompts and social norms include: completion of a site work plan to serve as a prompt in the future for each participant to remind them of their training and the projects they can implement on their site; signage on the implementation sites to prompt site owners and visitors to remind them of the importance of their water quality practices; and RCD, NRCS and Community Leaders serve to remind and reinforce water quality protection practices within the livestock community. All project activities assist the livestock community to develop a norm of water quality protective behavior among its members.

Uncertainties

The quality and quantity of the physical benefits detailed in this attachment are subject to the landowners that volunteer to participate in the program and the citizens within the region who choose to participate in the workshops and utilize the educational materials being provided. It will be important for the TCRCD to advertise the program and solicit projects for success.

Adverse Physical Effects

The only adverse physical effects are very short term, less than significant impacts, related to construction of the BMP's such as impacts related to construction noise and dust.

Annual Physical Benefits (Table 9)

The expected physical benefits of this program can be quantified through the use of indicator water quality parameters. TCRCD's project will directly reduce nutrient, pathogen and sediment load in surface waters. To provide an explanation of the type of benefit that can be measured, we have used total Kjeldahl nitrogen, total phosphorous and total coliform bacteria as indicators.

Sullivan (2010) wrote that because of certain compounds in manure, nutrient enrichment in nearby streams and rivers in the watershed is likely during a storm event. When Nicholson and Murray (2005) did a report on the effectiveness of BMPs specific to equine operations, they found that facilities that implemented BMPs have less pathogens, nutrients, and sediment discharge. This was the case for 16 of the 18 equine facilities examined, 13 of which were using effective BMPs (Nicholson and Murray 2005). Most studies are concerned about nitrogen and phosphorus, because these elements in other forms can be very harmful, even carcinogenic (Hubbard et al. 2004). Additionally, these nutrients can also induce eutrophication and algal growth and watersheds with concentrated livestock populations have been shown to discharge as much as 5 to 10 times more nutrients than watersheds in cropland or forestry (Hubbard et al. 2004).

Data from American Society of Agricultural Engineers (ASAE 2003) were used to quantify total loads and benefits expected from our project. For example, there are 0.3 lbs of total Kjeldahl nitrogen (TKN) and 0.071 lbs of total phosphorus (TP) entering the environment each day for every 1000 pound horse (ASAE 2003). If we install composting facilities or manure bins (with a designed lifespan of 15 years) that have the potential to alter manure management practices for 10 horses, the potential decreases in nutrients and pathogens can be dramatic.

Table 9 below provides an estimate of the physical reductions in nitrogen, phosphorous and coliform bacteria in runoff that might be expected with implementation of our project.

Table 9 – Annual Project Physical Benefits

Project Name: Tuolumne County Resource Conservation District Small Parcel Storm Water Pollution Prevention and Landowner Stewardship Program (T-S IRWM Project No. 16)

Type of Benefit Claimed: Reduction of Pollutant Loads by 50%

Measure of Benefit Claimed (Name of Units): Example: Pounds of Total Nitrogen per year, Pounds total phosphorous per year, Total Coliform colonies per year

Additional Information About this Measure: Assumptions: 1 horse produces 50 lbs of manure per day including 0.071 lbs total Phosphorous, 0.3 lbs Total Kjeldahl Nitrogen per day (18,250 lbs manure/horse/yr; 109 lbs TKN/Horse/yr and 83,300 Total Coliform bacteria colonies/yr). Also Assume our Project affects 10 horses (2 per project).

	(a)	(b)	(c)	(d)
		Physical Benefits		
Parameter	**Year**	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
Total Kjeldahl Nitrogen	**2013 - 2028**	1095 lbs/yr TKN 16,425 lbs/15 yrs TKN	547.5 lbs/yr TKN 8,212 lbs/yr TKN	Reduction of 547.5 lbs of TKN per year or 8,212 lbs TKN entering the environment over 15 years
Total Phosphorous	**2013- 2028**	255 lbs/yr total phosphorous 3835 lbs/15 yrs total phosphorous	127.5 lbs/yr total phosphorous 1915 lbs/15 yrs total phosphorous	Reduction of 127.5 lbs of total phosphorus per year or 1915 lbs of total phosphorus entering the environment over 15 years
Total Coliform Bacteria Colonies	**2013 - 2028**	23,740,695 Total Coliform colonies per horse/yr 356,110,425 Total Coliform colonies per horse/15yrs	11,870,348 Total Coliform colonies per horse/yr 178,055,213 Total Coliform colonies per horse/15 yrs	Reduction of 11,870,348 Total Coliform colonies per horse per year or 178,055,213 Total Coliform colonies per horse entering the environment over 15 years (multiply by 10 for total estimated project effect assuming 10 horses are included)

Comments: For every average horse (1,000 lbs), 51 lbs of manure (0.81 cubic feet) including 0.3 lbs of total Kjeldahl nitrogen (TKN), 0.071 lbs of total phosphorous, and 220 total coliform bacteria colonies/cu ft of manure is produced each day, and without manure management, these nutrients and pathogens can enter the surface and groundwater. Reference: American Society of Agricultural Engineers (ASAE). 2003. ASAE Standard: Manure Production and Characteristics. ASAE D384.1 FEB03. pp. 683-685. Assume installing a manure bin or compost facility would reduce pollutant load in runoff from a manure pile by 50%. Composting Facility has a 15 year lifespan (NRCS Standard)

References

American Society of Agricultural Engineers (ASAE). 2003. ASAE Standard: Manure Production and Characteristics. ASAE D384.1 FEB03. pp. 683-685.

Hubbard, RK, GL Newton, and GM Hill. 2004. Water Quality and the Grazing Animal. Journal of Animal Science. 82(E-Supplement):E255-E263.

Nicholson, D and M Murphy. 2005. Assessment of Best Management Practices for Equestrian Facilities in the Tomales Bay Watershed. Marin County Stormwater Pollution Prevention Program, San Rafael, CA.

Sullivan, Kate. 2010. Literature Review: Equine Facility Runoff. Rutgers University Water Resources Program. http://water.rutgers.edu/Research/Research.html#ecological

Amador Tuolumne Community Action Agency Home-Level Water Conservation for the DAC (T-S IRWM Project No. 17)

ATCAA's Home-Level Water Conservation for the DAC project has physical benefits in the form of water saved. In addition, because this project serves the lowest tier of the DAC, it has numerous social and economic physical benefits that cannot be quantified.

Project Physical Benefits

Water Supply

Summary of Benefit:
The ATCAA "Home-Level Water Conservation for the DAC" improves water supply by reducing demand. Water conservation is a necessary component of any strategy that addresses water supply. As part of the ATCAA Home-Level Water Conservation Program Energy Star appliances and low flow fixtures will be installed in DAC households. This proposed Home-Level Water Conservation Program would be an extension of an existing program, and would extend energy conservation efforts to include water conservation in the same homes. Over the anticipated useful life of the measures to be installed (on average 12 years) the project would save approximately 182 acre feet of water.

Secondary benefits of water conservation include;

Social Benefits:
For the lowest income households within this region, purchasing an adequate supply of water to meet their daily needs can be a financial hardship. ATCAA has found that members of the DAC, because of their lower incomes, are less likely to spend money on water conservation measures, even if it could result in a future savings. This is compounded in times of drought when these communities are disproportionately burdened by enforced conservation measures. The benefit of implementing this project will be that households which otherwise could not afford to make these upgrades will now have access to their benefits.

Power Cost Savings Benefit:
As part of the proposed project, appliances and low flow fixtures will be installed. This will improve the energy efficiency of the home-level infrastructure by reducing the amount of water that needs to be heated, and saving the corresponding energy.

Recent and Historical Conditions:
The water supply infrastructure in this region is aging and is proving insufficient in the wake of multi-year droughts. This region is largely served by an open ditch network originally constructed during the gold rush. If the flumes involved fail, if human interaction pollutes the ditch water, if snow or vegetation overwhelms the ditches, or if the ditch simply fails, water distribution is interrupted without warning. These are all events that have happened in the past. Additionally, California has recently suffered several years of drought conditions and critical

water supply sources have become less dependable. In multi-year droughts surface water levels in reservoirs have dropped precipitously and threatened the continuity of water supply. Modifying the water supply system to increase efficiency is a critical measure for ensuring that the minimum required quantity of water is delivered to users. In-home water conservation is an important component of efficiency gains, but is often neglected especially in the homes of members of the DAC who lack the financial resources to make the necessary improvements. Water is also becoming more expensive. For the lowest income household in this region, purchasing an adequate supply of water for daily needs can be a financial hardship.

In the past, water districts have attempted to compel end users to conserve water through metering and charging higher rates for the heaviest users. In addition, districts have also attempted outreach and education. The Tuolumne Stanislaus Region has never had a hands-on home-level water conservation program.

These tactics have little effect on the DAC, although the DAC often has a slightly lower base rate in many areas. The members of the DAC, and more specifically, the members of the severely disadvantaged community are generally concentrating on day-to-day survival and water supply issues are not a priority. In addition, higher-than-average proportion of the DAC is comprised of renters who are unable to make home improvements that will result in saved water. ATCAA has found that members of the DAC because of their lower incomes and are less likely to spend money on water conservation measures, even if it could result in a future savings. Making home improvements for future savings is not a reasonable option for those households within the DAC.

Without Project Conditions:
Without this project the indoor water consumption would be 550 acre feet in the 192 households over the expected project life. The potential savings of 182 acre feet would not be realized without project implementation. Additionally, without the proposed project it would be more difficult for these DAC households to implement water conservation measures.

Methodology:
According to a comprehensive report on urban water conservation (Cain 2003) implementation of the types of efficiency measures that will be implemented by this project (including low flow fixtures and upgrading to energy star appliances) would result in an average water savings of 23 gallons per day per person. Using an assumption of 2.5 persons per household and 192 homes to be served by this project, this project could result in savings of 4,029,600 gallons (12.4 acre feet) annually for indoor use alone. Over the anticipated useful life of the measures to be installed (on average 12 years) the project would save approximately 182 acre feet of water.

Relationship to other Projects

Synergies exist with the Tuolumne River Trust who will distribute ATCAA materials at their various outreach events and other functions. In addition, ATCAA will provide outreach materials to all of the members of the IRWM group, particularly the water districts, in an effort to reach the members of the DAC and to offer this valuable service.

ATCAA's project is designed to "stand alone", however it can also be viewed as a component of all other projects in this proposal since all projects will benefit by water conservation.

Facilities, Policies and Actions

ATCAA will have to develop a water audit procedure in order to expend their existing program to include water conservation upgrades. Other than the water audit procedures all facilities, policies, and actions exist within ATCAA's existing programs.

Uncertainties

The benefits claimed for this project will depend on the measures installed and the number of homes and measures we are able to serve. Until our assessors visit a home, it is uncertain which measures are needed. We have supplied average per-home numbers of measures in our project budget, but each home is different and changes to those average numbers should be anticipated. This project will install the maximum measures possible and will stop all activity once the grant amount has been used.

Adverse Physical Effects

No adverse physical effects are anticipated.

Annual Physical Benefits (Table 9)

Table 9 – Annual Project Physical Benefits

Proposal Title: Amador Tuolumne Community Action Agency Home-Level Water Conservation for the DAC (T-S IRWM Project No. 17)

Type of Benefit Claimed: Water supply savings.

Measure of Benefit Claimed (Name of Units): Acre feet of water

Additional Information About this Measure: Acre feet of water used by the 192 homes serviced by this project.

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2013	32.3	31.5	0.8
2014	32.3	28.4	3.9
2015	32.3	25.3	7.0
2016	32.3	22.3	10.0
2017	32.3	20.0	12.3
2018	32.3	20.0	12.3
2019	32.3	20.0	12.3
2020	32.3	20.0	12.3
2021	32.3	20.0	12.3
2022	32.3	20.0	12.3
2023	32.3	20.0	12.3
2024	32.3	20.0	12.3
2025	32.3	20.0	12.3
2026	32.3	20.0	12.3
2027	32.3	20.0	12.3
2028	32.3	20.0	12.3
2029	32.3	20.0	12.3
		Total	**182**

Comments: Calculations are based on water use of 0.1068 acre feet of water per year in untreated homes and 0.104 acre feet in homes where efficiency measures are installed (Cain 2003). Estimated schedule is 12 homes implemented in 2013, 48 homes implemented in 2014-2016, and 36 homes implemented in 2017. The useful life of the installed measure is estimated to be 12 years.

References

Cain, N. L. 2003. Waste not, want not. The potential for urban water conservation in California. Pacific Institute for Studies in Development, Environment, and Security. Oakland, Ca. 165pp.

Tuolumne Utilities District Phoenix Lake Preservation and Restoration-Phase 2 (T-S IRWM Project No. 18)

The Phoenix Lake Preservation and Restoration-Phase 2 project is designed to improve the water quality and restore storage capacity in Phoenix Lake and the Phoenix Lake watershed (see Figure 1-1). A very comprehensive and diverse plan has been developed for the restoration and preservation of Phoenix Lake and the surrounding watershed. This project will finalize the 30% design completed in the Plan, complete all necessary environmental reviews and obtain the required permits to implement the Plan.

Project Physical Benefits

Water Supply

Summary of Benefit:

The Phoenix Lake Preservation and Restoration-Phase 2 project, once fully implemented, will restore storage capacity to Phoenix Lake. Phoenix Lake is an 88-acre water storage reservoir located approximately 3 miles east of the City of Sonora in Tuolumne County, California. Phoenix Lake water rights and facilities, as well as portions of the lake, are owned by the Tuolumne Utilities District (TUD). The TUD uses the lake as a primary drinking water source for the communities of Sonora, Jamestown, Scenic View and Mono Village.

The contemporary Phoenix Lake reservoir was constructed in 1880. Since that time the storage capacity of the lake has decreased substantially due to sedimentation. A comparison of bathymetric surveys from 2002 and 2010 suggests that on average approximately 4,600 cubic yards (cy) of sediment enters the lake annually. This sediment delivery estimate is more than three times the rate reported in previous studies. While the allowable storage capacity of the lake is approximately 900 acre-feet (ac-ft), the current capacity is only 600 ac-ft. Reduced lake capacity affects the water quality at Phoenix Lake, which is marginal at times and is declining due to nutrient inputs, sedimentation and exotic invasive aquatic vegetation.

The annual loss of storage capacity is approximately 2.8 ac-ft which equates to the water supply for 9 homes on an annual basis. As shown on Figure 1-2 of the work plan, 83% of the service areas supplied by Phoenix Lake are within a DAC. By restoring lake capacity, additional water supply will be made available to the service area.

One of the components of the Plan is the creation of the Sullivan Creek sediment forebay. The forebay was designed to be large enough to effectively trap sediment and minimize the frequency of maintenance. The proposed usable volume is 3,310 cy. This equates to 70% of the estimated average annual deposition in the lake. The Sullivan Creek watershed accounts for 67% of the lake's contributing drainage area. While all sub-watersheds draining to the lake are not likely to contribute sediment proportionally, it is anticipated that the Sullivan Creek forebay will have sufficient capacity to capture the expected annual delivery of coarse suspended load and bedload. The forebay inlet weir is sized to accommodate a 10-year return

storm flow (Q10) of approximately 1,400 cubic feet per second (cfs).

Recent and Historical Conditions:
A comparison of bathymetric surveys from 2002 and 2010 suggests that on average approximately 4,600 cubic yards (cy) of sediment enters the lake annually. This sediment delivery estimate is more than three times the rate reported in previous studies. While the historical allowable storage capacity of the lake is approximately 900 acre-feet (ac-ft), the current capacity is only 600 ac-ft. The annual loss of storage capacity is approximately 2.8 ac-ft which equates to the water supply for 9 homes on an annual basis.

Without Project Conditions:
Historical and current data shows that the storage capacity of the lake has decreased substantially due to sedimentation. A comparison of bathymetric surveys from 2002 and 2010 suggests that on average approximately 4,600 cubic yards (cy) of sediment enters the lake annually. This sediment delivery estimate is more than three times the rate reported in previous studies. While the allowable storage capacity of the lake is approximately 900 acre-feet (ac-ft), the current capacity is only 600 ac-ft. Reduced lake capacity affects the water quality at Phoenix Lake, which is marginal at times and is declining due to nutrient inputs, sedimentation and exotic invasive aquatic vegetation.

The annual loss of storage capacity is approximately 2.8 ac-ft which equates to the lost water supply for 9 homes on an annual basis.

If the project is not completed the lake will continue to fill with sediment, decreasing the storage capacity and promote the proliferation of aquatic vegetation. These factors contribute to declining water quality conditions.

Methodology:
By comparing bathymetric surveys from 2002 and 2010 the data suggests that on average approximately 4,600 cubic yards (cy) of sediment enters the lake annually. This sediment delivery estimate is more than three times the rate reported in previous studies. While the allowable storage capacity of the lake is approximately 900 acre-feet (ac-ft), the current capacity is only 600 ac-ft. Reduced lake capacity affects the water quality at Phoenix Lake, which is marginal at times and is declining due to nutrient inputs, sedimentation and exotic invasive aquatic vegetation.

The annual loss of storage capacity is approximately 2.8 ac-ft which equates to the water supply for 9 homes on an annual basis. The Lake Plan proposes to remove more than 400,000 cy of sediment from the lake. Wetland enhancements include floodplain and channel reconstruction to provide habitat diversity and manage sedimentation patterns.

The proposed sediment forebay will trap coarse sediment entering the lake. When implemented, the Lake Plan will restore storage capacity in the reservoir while

preserving recreational, aesthetic and wetland values at the lake. Assuming an average annual deposition rate of 4,600 cy, removing more than 400,000 cy of sediment would extend the life of the reservoir by more than 85 years.

Water Quality, Water Treatment

Summary of Benefit:
The Phoenix Lake Preservation and Restoration Plan-Phase 2 will provide complete designs, specifications, environmental documentation, and land purchase (for the proposed sediment forebay) addressing water quality improvements for the lake. Raw water quality is proportionate to the level of treatment required to create potable drinking water that meets or exceeds state standards. Improvements to the lake and watershed will create improved water quality and allow treatment costs and effort to decrease.

Recent and Historical Conditions:
Between November 2010 and October 2011, direct measurements of water quality parameters were collected in and around Phoenix Lake. The purpose of these sampling efforts was to characterize water quality in the lake, an effort that has not been conducted in the past. The monitoring program aimed to characterize water quality condition in the context of the designated beneficial uses of the Upper Tuolumne watershed as established by the Central Valley Regional Water Quality Control Board (RWQCB, 2009). The beneficial uses that apply to Phoenix Lake include water supply, non-water contact recreation (e.g., boating), and wildlife habitat. The monitoring program also considered factors that contribute to lake aesthetics (e.g., extent of aquatic vegetation, water clarity). Discrete measurements of general water chemistry, bacteria, and nutrients were taken on February 3, August 3, and September 20, 2011.

Without Project Conditions:
If the next phase (Phase 2) of the Phoenix Lake Preservation and Restoration is not done, then the sustainable health of the lake cannot be predicted. Phase 2 is critical to the overall preservation and restoration project. Completed plans, specifications, environmental documentation and permitting will allow Phase 3, construction implementation to take place. If sediment loading rates continue or increase, the lake will lose the storage volume to supply approximately 9 homes a year. As the sediment deposition on the lake increases the water quality will continue to decline thus making treatment of the water more difficult and expensive.

Methodology:
The Phoenix Lake Preservation and Restoration-Phase 2 does not have a physical water quality benefit. The project consists of developing construction plans and specifications, environmental documentation, permitting, and land purchase. All physical water quality benefits will be established in Phase 3. Post Phase 3 water quality improvements will be measured by comparing water quality parameters to pre-construction values.

Relationship to other Projects

Phoenix Lake Preservation and Restoration-Phase 2 integrates well with other projects in the Tuolumne-Stanislaus IRWM. The Stanislaus National Forest Upper South Fork Stanislaus River Watershed Restoration and Water Quality Enhancement Project will provide water quality improvements in the upper watershed that is a source of supply to Phoenix Lake. Tuolumne County Resource Conservation District's Small Parcel Stormwater Pollution Prevention and Landowner Stewardship Program will achieve reductions in nutrient, sediment and pathogen pollution to surface and ground waters in the Tuolumne and Stanislaus River watersheds through education, outreach and implementation of efficient and effective BMPs on small acreage livestock facilities to manage drainage, mud, vegetation and manure. ATCAA's In-Home Water Conservation for the DAC will help water use efficiency in DAC's, 83% of the service area supplied by Phoenix Lake is in a DAC. Tuolumne River Trust's Watershed Outreach and Stewardship will focus on spreading the message about watershed health and water use efficiency while involving the community in watershed stewardship, including the Phoenix Lake watershed.

Facilities, Policies and Actions

Phoenix Lake Preservation and Restoration-Phase 2 does not include any new facilities, policies or actions to achieve the physical benefits identified above.

Uncertainties

Phoenix Lake Preservation and Restoration-Phase 2 does not include any uncertainties to achieve the physical benefits identified above.

Adverse Physical Effects

There are no adverse physical effects associated with the Phoenix Lake Preservation and Restoration-Phase 2.

Annual Physical Benefits (Table 9)

Table 9 – Annual Project Physical Benefits **Project Name: Tuolumne Utilities District Phoenix Lake Preservation and Restoration-Phase 2 (T-S IRWM Project No. 18)** **Type of Benefit Claimed: Water Quality** **Measure of Benefit Claimed (Name of Units): Acre Feet** **Additional Information About this Measure: Acquisition of Property for the Proposed Sediment Forebay**			
(a)	**(b)**	**(c)**	**(d)**
	Physical Benefits		
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2014	0	2	2 acre feet
2015	0	2	2 acre feet
2016-2099	0	166	166 acre feet
		Total:	**170 acre feet**
Comments: By acquiring the necessary of property for the sediment forebay, TUD will be able to change the use of the property reducing the degradation of water quality caused by the current agricultural use.			

Table 9 – Annual Project Physical Benefits **Project Name: Tuolumne Utilities District Phoenix Lake Preservation and Restoration-Phase 2 (T-S IRWM Project No. 18)** **Type of Benefit Claimed: Water Quality (Potential)** **Measure of Benefit Claimed (Name of Units): Acre Feet** **Additional Information About this Measure: Lake Restoration**			
(a)	**(b)**	**(c)**	**(d)**
	Physical Benefits		
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2018	0	200	200 acre feet
2019	0	200	200 acre feet
2020-2099	0	15,800	15,800 acre feet
		Total:	**16,200 acre feet**
Comments: Assumes implementation of Phase 3 of the Phoenix Lake Preservation and Restoration Plan.			

Tuolumne River Trust Tuolumne-Stanislaus Watershed Outreach and Stewardship (T-S IRWM Project No 22)

The purpose of this project is two-fold: to deliver a unified regional message about the importance of watershed health and water use efficiency and to involve the community in watershed stewardship through volunteer workday activities.

Through an outreach campaign we will raise the community's awareness of where its water comes from, the importance of a healthy watershed, and where runoff ultimately flows. The stewardship component of the project will improve habitat conditions at specific projects within the watershed.

Project Physical Benefits

Water Supply

Summary of Benefit:
Through this outreach program, we expect to directly engage 440 people in presentations, events, and workdays. Additionally, we will reach people through media placements (newspaper, web, and/or radio).

Based on a number of assumptions described below, we would expect to realize a water savings of approximately 3,510 gallons/day or 1,281,000 gallons per year.

Recent and Historical Conditions:
Current per capita water use within the Tuolumne Utilities District is 187 gallons per day while water use within Calaveras County Water District is 215 gallons per day. Due to limited water rights and water supply, coupled with the region's Mediterranean climate, at times the region faces water shortages and is forced to implement water conservation measures, either voluntary or mandatory. As recently as June 2012, the Tuolumne Utilities District implemented "Phase III" mandatory water conservation measures, which made all "Phase II" voluntary measures mandatory. These measure included restricted times of landscape irrigation, plus prohibitions on washing exterior hard surfaces.

Without Project Conditions:
Without this project but with continued efforts of other projects, we would expect to see some level of reductions in water use. The Tuolumne Utilities District has a target of 176 gallons per capita per day by 2015 and the Calaveras County Water District has a target of 194 gallons per capita per day by 2015. We would expect that these two agencies and other water purveyors within the region (data was only available for TUD and CCWD) would make progress towards these goals, although we do not have information that shows the progress to date on those goals.

Methodology:
Through our messaging and outreach, we will directly engage 440 people via presentations, events, and workdays. We will reach additional community members through three media placements per year (newspaper, web, and/or

radio). There are two local newspapers. The Union-Democrat has a circulation of 26,000 readers each day, and its website has 420,000 views each month. The Calaveras Enterprise reaches 50,000 readers each week. The local news radio station, KVML, broadcasts to the entire Tuolumne Stanislaus IRWM Region with a combined population of approximately 70,000 people, although an unknown number of them are actually listeners of the radio station, or view its corresponding website.

If we assume that 10% of those directly engaged over one year of the project (22) plus an additional 0.1% of the total population of the region reached through media placements (70) modify their water use practices each year, then approximately 95 people would adopt water saving practices. Per capita water use within the region is approximately 200 gal/day. If, on average, those who adopt water savings practices save 15% of their water, then that would represent a reduction of 30 gal/day to 170 gal/day of use. Expanding this to the 95 participants we realize a savings of 2,850 gal/day or 1,040,250 gallons per year in total savings.

Water Quality, Water Treatment

Summary of Benefit:
Through this project, residents will learn about surface water runoff and where water ultimately goes. This outreach message coupled with water saving approaches, in particular savings in landscape irrigation, we would expect to see a reduction in surface water runoff, thus a corresponding reduction in sediments and pollutants entering local waterways.

Although we expect that some percent of residential water savings would come from reductions in landscape water use, and that this would result in a reduction in surface water runoff, there would be some reduction of sediment and contaminants that enter local waterbodies. However, the percent of reduction in sediment and contaminants is very difficult to develop a credible estimate and thus we do not quantify this benefit.

Environ-mental Benefits

Summary of Benefit:
Through the stewardship component of this project, we will contribute to restoration and cleanup of local creeks, meadows, and other habitat types. We expect that we will help restore and/or cleanup approximately 10 acres of meadow habitat and approximately 1 linear mile of streambed. We will work with the Stanislaus National Forest and other agencies to identify “shovel-ready” projects in which volunteer work can be incorporated to help complete the work.

Recent and Historical Conditions:
There are currently a number of degraded meadows within the Tuolumne Stanislaus IRWM Region that are targeted for restoration. Most of these are on Stanislaus National Forest land, although some are located on other public and private lands. These meadows include the seven meadows listed in the Upper South Fork Stanislaus River Watershed Restoration and Water Quality Enhancement Project included in this IRWM proposal, the Wolfin Meadows and

the Fahey Meadows, which are in the planning phases, as well as a meadow located in the Upper Phoenix Creek watershed on public land. Beyond these meadows, there are a number of locations in the Stanislaus National Forest that are targeted for noxious weed removal, in particular oxeye daisy and yellow star thistle.

Without Project Conditions:
Without this project the Stanislaus National Forest will continue to seek funding to complete restoration activities. However many of these projects have proven difficult to fund and complete solely with Federal funding – additional funding has accelerated the completion of similar projects in the past. So we would expect that this work would ultimately be completed, however it may take longer.

Methodology:
The Stanislaus National Forest has identified 130 acres of meadows in need of restoration as part of the Upper South Fork Stanislaus River Watershed Restoration and Water Quality Enhancement Project. Additionally, Lower Fahey Meadow, 2N55 Meadow, Wolfin Meadow Main, and Wolfin Meadow North represent another 6 acres and the Upper Phoenix Watershed Meadow represents an additional 5 acres.

We would not have volunteers contribute towards all of these projects, but rather only select activities on some of these projects, depending on the specific project, activities, and schedule. We anticipate that we will be able to contribute towards at least 10 acres of restoration through this project, as well as restoring and/or cleaning 1 mile of stream channel.

Relationship to other Projects

This project will primarily act as an outreach component of the overall IRWM effort and will be designed to deliver basic information about other projects in this proposal. For this we will use information about the other projects and integrate them into the outreach materials created for this project. We will specifically identify the benefits the other projects are providing to water supply, water quality, watershed health, and ecosystem benefits.

Beyond this, this project will take advantage of opportunities presented by other projects, both those that are part of this proposal and those that are not, to incorporate a volunteer stewardship component.

The Tuolumne River Trust has a long track record of managing restoration projects and organizing volunteer workdays to undertake restoration. Over the past decade we have regularly organized volunteer workdays at various locations throughout the Tuolumne watershed. We have worked with the Stanislaus National Forest on trail workdays and meadow restoration. We have also organized creek and campsite cleanups. In the lower watershed, we have organized restoration workdays at the Big Bend Restoration Project, the Dos Rios Ranch Project, and at other locations along the lower Tuolumne River, so we are confident that we will be able to complete this component of the project.

Facilities, Policies and Actions

N/A

Uncertainties

There is a degree of uncertainty in the water supply benefits identified above. It is difficult to predict what percentage of participants in the program will ultimately adopt water saving practices in their lives. It is also difficult to know what number of people who read or hear a news story will ultimately adopt water saving practices. Furthermore, for any individual we reach, it is difficult to know whether our effort alone convinced them to adopt a new practice or technology, or if our message in combination with the message put out by other outreach programs in the region and in the State ultimately convinced them to change. Our own experience supports the idea that people generally need to hear about an idea repeatedly before they finally change their own practices, and so we view this effort as part of an ongoing campaign to continuously provide information about water efficiency and watershed health.

Adverse Physical Effects

We do not believe there will be any adverse physical effects from this project.

Annual Physical Benefits (Table 9)

Table 9 – Annual Project Physical Benefits			
Project Name: Tuolumne River Trust Tuolumne-Stanislaus Watershed Outreach and Stewardship (T-S IRWM Project No 22)			
Type of Benefit Claimed: Water Supply			
Measure of Benefit Claimed (Name of Units): gallons			
Additional Information About this Measure: gallons per year of water savings			
(a)	**(b)**	**(c)**	**(d)**
	Physical Benefits		
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2012	0	0	0
2013	0	0	0
2014	6,935,000	5,894,750	1,040,250
2015	6,935,000	5,894,750	1,040,250
		TOTAL	**2,080,500**
Comments: We anticipate a total of 2,080,500 gallons of water saved as a result of this project.			

Table 9 – Annual Project Physical Benefits			
Project Name: Tuolumne River Trust Tuolumne-Stanislaus Watershed Outreach and Stewardship (T-S IRWM Project No 22)			
Type of Benefit Claimed: Environmental			
Measure of Benefit Claimed (Name of Units): acres			
Additional Information About this Measure: acres per year of habitat restoration			
(a)	**(b)**	**(c)**	**(d)**
	Physical Benefits		
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2012	0	0	0
2013	0	0	0
2014	0	5	5
2015	0	5	5
		TOTAL	**10**
Comments: We anticipate that we will restore 10 acres of habitat (including at least 1 mile of stream).			

Calaveras County Water District Douglas Flat/Vallecito Storage Pond Project (T-S IRWM Project No. 25)

The Calaveras County Water District recently upgraded its Douglas Flat/Vallecito Wastewater Treatment Plant to tertiary treatment with a design flow of 86,500 gallons per day. Since completion of plant upgrades State regulations have changed to require additional storage capacity for the upgraded facility; an additional 26.8 acre feet of storage is now required.

This proposed design phase project will be the first step in increasing the storage capacity of the effluent reservoir near the existing Douglas Flat/Vallecito Wastewater Treatment Plant to allow for full utilization of the entire design capacity of the facility.

The new storage pond would insure that all existing infill and existing septic facilities would be able to tie into the facility. This would have a positive impact on groundwater quality in the area. The original wastewater plant was built in order to mitigate public health concerns. Although the plant has reduced these concerns, further improvement to eliminate septic tanks would benefit water quality.

In addition to the water quality benefits listed above, there is a strong potential for recycled water use, including agricultural if the storage ponds are expanded. There are a number of local vineyards and wineries that would be able to put the reclaimed water to beneficial use. For several years, California has experienced drought conditions, and critical water supply sources, such as the Stanislaus River, have become less dependable. A larger storage pond, along with the permits and Title 22 authorization, will provide additional, reliable and a sustainable supply high of quality tertiary treated water, even in times of drought. This supply will help reduce raw water diversions from the Stanislaus River.

In summary, the benefits of this project to the Douglas Flat/Vallecito area are:

1. Provides additional treatment and storage pond capacity that ensures all infill and existing septic facilities have the ability to tie into the treatment facility. This would have a positive impact on the drinking wells and groundwater in the area.
2. Reduces the discharge to, and storage of, treated effluent to the Douglas Flat/Vallecito Wastewater Treatment Facility Storage Pond and spray fields.
3. Provides reclaimed water to local agriculture and helps reduce dependence on raw water from the Stanislaus River.

Project Physical Benefits

Water Supply

Summary of Benefits:
Implementation of this project, which includes development of plans and designs for storage capacity expansion, will serve as an important step toward creating greater storage pond capacity. This expanded capacity, along with the permits and Title 22, will provide additional, reliable and sustainable supply of high quality tertiary treated water, even in times of drought. If put to beneficial use, this supply will help reduce raw water diversions from the Stanislaus River.

Recent and Historical Conditions:
A number of local vineyards would be able to put the reclaimed water to beneficial

use. For several years, California has experienced drought conditions, and critical water supply sources, such as the Stanislaus River, have become less dependable. Agriculture is a key industry in the Douglas Flat/Vallecito/Murphys area, and water reliability is critical to its economic health.

Without Project Conditions:
Continued use of spray fields for the disposal of tertiary treated effluent will prevent the possible use of treated water for agriculture. This would continue agriculture's reliance on raw water diversions from the Stanislaus River.

Methodology:
This proposed design phase project will be the first step in increasing the storage capacity of the effluent reservoir near the existing Douglas Flat/Vallecito Wastewater Treatment Plant thereby creating the opportunity for treated effluent to be used for agriculture or other beneficial use. This would reduce current and future diversions of raw water from the Stanislaus River. Currently the 83.9 acre feet of treated water that is processed and stored by CCWD is used on sprayfields as permitted. If the District obtains a Title 22 permit and adds the additional proposed storage there would be 96.8 acre feet of Title 22 tertiary treated water available for agriculture and other beneficial uses.

Water Quality, Water Treatment

Summary of Benefit:
Implementation of this project, which includes development of plans and designs for storage capacity expansion, will serve as an important step toward creating greater storage pond capacity. The recent plant upgrades, in conjunction with the expanded storage capacity, will allow the District to serve all existing septic systems and new infill homes in the Douglas Flat/Vallecito area.

Recent and Historical Conditions:
Since 2005, the Douglas Flat/Vallecito area has been subject to a CCWD moratorium on new wastewater connections due to wastewater treatment plant limitations. The result was that any new homes built in the area required septic systems. It also limited the ability of existing homes with septic systems to connect to the District's collection and treatment system.

The Calaveras County Groundwater Protection Program Final Report indicates that the concentration of onsite septic systems within the service area of the project ranges up to 500 per square mile. The report finds that both groundwater and surface waters may be impaired which is a public health and safety concern. Calaveras County receives a number of complaints regarding failed septic systems annually.

Without Project Conditions:
Without the proposed project, plans and designs for the expanded storage facility would not be created, and thus the storage facility itself would not be constructed. Without additional storage capacity, current concentration of onsite septic systems within the service are of the project will continue to be approximately 500

per square mile. If implemented, the expansions planned for as a part of this project will provide increased capacity for existing septic systems in the District's service area to connect, thus protecting groundwater resources.

Methodology:
Construction of the new tertiary treatment facility demonstrates the need for supplemental disposal capacity. Harm to public health and surface waters can be caused by nuisance wastewater. This is the method used to determine the physical benefit. The quantity of supplemental disposal capacity this project would make available to the district was evaluated through a feasibility study for Vallecitio/Douglas Flat reservoir (Hanson, 2007).

Relationship to other Projects

This project integrates with the reconstruction of Groveland Community Service District's lift station and Murphys Sanitary District Sprayfield by working toward the common IRWM objective of improving infrastructure to meet wastewater discharge/disposal requirements for DAC's. Completion of this suite of projects will protect water resources in the T-S IRWM Region from contamination. They further complement each other and the other projects in this proposal on a regional basis by meeting Statewide Priorities of using and reusing water more efficiently and protecting surface and groundwater quality.

Facilities, Policies and Actions

The facility improvements and existing District policies for providing wastewater services make this project beneficial to both the residents and agricultural interest in this disadvantaged community.

Uncertainties

The proposed planning and design project does not include any uncertainties to achieve the physical benefits identified above.

Adverse Physical Effects

There are no adverse physical effects of this phase of the project as it only includes planning and design for future implementation.

Annual Physical Benefits (Table 9)

Table 9 – Annual Project Physical Benefits			
Project Name: Calaveras County Water District Douglas Flat/Vallecito Storage Pond Project (T-S IRWM Project No. 25)			
Type of Benefit Claimed: acre feet of tertiary treated water available for beneficial use per year			
Measure of Benefit Claimed (Name of Units): acre feet of tertiary treated water per year			
Additional Information About this Measure:			
(a)	**(b)**	**(c)**	**(d)**
	Physical Benefits		
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	96.8	96.8
2014	0	96.8	96.8
2015-2052	0	96.8	3678.4
		TOTAL	**3872**
Comments: Existing annual volume of treated water of 83.9acft/yr will increase to 96.8acft/yr (additional 12.9acft/yr) with project implementation. Existing annual volume of treated water is not put to beneficial use because CCWD has not had the resources to secure the necessary Title 22 permit. Implementation of this project includes pursuit of a Title 22 permit, which would allow for the entire annual volume of treated water (96.8acft/yr) to be put to beneficial use.			

Groveland Community Services District GCSD/BOF (LS#16) Water Quality Protection Project (T-S IRWM Project No. 27)

Doing these improvements to this sewer lift station, which pumps about 10,000 gallons of raw sewage per day, will virtually eliminate the probability of a sewer spill, which could otherwise happen as often as twice per year. Not having this kind of volume of raw sewage deposited into Rattlesnake Creek and Don Pedro Reservoir will be a huge environmental and water quality protection benefit.

Project Physical Benefits

Water Quality, Water Treatment

Summary of Benefit:
The water quality protection benefit that this project will provide is significant in that it mitigates the potential of a spill into Rattlesnake Creek and Don Pedro Reservoir, which would drastically degrade water quality. An estimated spill of up to 10,000 gallons per day of raw sewage into Rattlesnake Creek and Don Pedro Reservoir has the potential to contaminate the domestic water supply for a population of approximately 210,000 and affect the raw water supply for over 200,000 irrigated acres of agricultural land (HDR Engineering, 2013). The remaining in stream flows are heavily regulated by FERC licensing to ensure sufficient water flow into the Tuolumne River and Bay Delta. A raw sewage spill would also impact downstream beneficial uses including habitat for special status fish and wildlife species dependant on the Bay Delta ecosystem.

In addition to impacting domestic, raw, and environmental water resources the existing extensive recreational opportunities related to Don Pedro Reservoir would be compromised. The Don Pedro Reservoir is utilized by between 300,000-350,000 visitors annually (TID/MID, 2011).

Recent and Historical Conditions:
Existing storage capacity would not be sufficient to contain sewage flows in the case of lift station failure. The GCSD District Engineer has determined that in the case of lift station failure existing storage capacity would be sufficient for 50 minutes, after which the raw sewage would begin spilling into Rattlesnake Creek. Due to the remote location of this lift station 50 minutes is not sufficient time to get a vacuum truck to the site in the case of failure. Implementation of the proposed project will increase the storage capacity to over 600% of what currently exists, further extending response time to approximately 5 hours.

Without Project Conditions:
Should this sewer lift station fail the GCSD District Engineer estimates that up to 10,000 gallons of raw sewage could be spilled per day per occurrence. As described above this impact would be devastating to quality of domestic, raw, and environmental water resources, as well as the environment of Rattlesnake Creek, Don Pedro Reservoir, and the Bay Delta.

Methodology:
GCSD has quantified the potential for lift station failure with and without the project in Table 9, which has been provided at the end of this project's description of benefits. All but one lift station within the District have been upgraded to the level proposed in this project for Lift Station #16. None of the upgraded lift stations have failed since upgrading occurred. The GCSD District Engineer estimates that the average potential spill from Lift Station #16 would be approximately 10,000 gallons per spill occurrence based on response times and existing station capacity. Without the upgrade, and assuming two occurrences per year, Lift Station #16 could potentially spill up to 20,000 gallons each year. With the upgrade, it is assumed that Lift Station #16 will perform similarly to the other stations in the District and the potential for future spills will be negligible or non-existent.

Power Cost Savings and Power Production

Summary of Benefit:
By replacing the existing lift station pump, the GCSD District Engineer estimates that the District will save approximately 30% on power costs for this lift station. The actual cost savings will be approximately $100 per month.

Recent and Historical Conditions:
This lift station currently costs approximately $300 per month to operate.

Without Project Conditions:
Without this project this lift station will continue to cost approximately $300 per month to operate, and these costs are anticipated to increase in the future.

Methodology:
All but one lift station within the district have been upgraded to the level proposed in this project for Lift Station #16. The cost savings realized by these prior replacements provided District staff with an estimate for possible savings at Lift Station #16.

Energy

Summary of Benefit:
By replacing the existing lift station pumps with multiple, more efficient pumps which are installed in series, we will save approximately 30% of power usage, which equates to approximately 1,500 KW per month.

Recent and Historical Conditions:
This lift station currently averages approximately 5,000 KW of power used per month.

Without Project Conditions:
This lift station currently averages about 5,000 KW of power used per month.

Methodology:
We have accurate data on monthly costs to operate this sewer lift station. The savings in energy are displayed as cost savings in detail in Table 9.

Relationship to other Projects

Reconstructing GCSD's lift station addresses the common T-S IRWM objective of improving infrastructure to meet wastewater discharge/disposal requirements for DAC's. As such, this project integrates with installation of Murphys Sanitary District spray field and expansion of Calaveras County Water District wastewater pond. They further complement each other and the other projects in this proposal on a regional basis by meeting Statewide Priorities of using and reusing water more efficiently and protecting surface and groundwater quality.

Facilities, Policies and Actions

The proposed project will be implementing the construction of lift station facilities. All physical benefits will be a result of lift station replacement; no additional policies or actions are required.

Uncertainties

The only uncertainties associated with replacing this lift station relates to those normally incurred by construction projects, including; acquisition of materials and equipment, labor, etc.

Adverse Physical Effects

There are no adverse physical effects of implementing this project. The only adverse physical effects will occur in the form of potential sewage spills into Rattlesnake Creek and Don Pedro Reservoir if funding for this project is not secured.

Annual Physical Benefits (Table 9)

Table 9 – Annual Project Physical Benefits			
Project Name: Groveland Community Services District GCSD/BOF (LS#16) Water Quality Protection Project (T-S IRWM Project No. 27) **Type of Benefit Claimed: Avoidance of 10,000 gallons of raw sewage spilled per occurrence per year** **Measure of Benefit Claimed (Name of Units): Gallons per occurrence** **Additional Information About this Measure: Assumes a probability of 2 spills per year without Project with a spill estimate of 10,000 gallons per occurrence.**			
(a)	**(b)**	**(c)**	**(d)**
	Physical Benefits		
Year	**Spill Volume Without Project**	**Spill Volume With Project**	**Change Resulting from Project (b) – (c)**
2014	20,000	0	20,000
2015	20,000	0	20,000
2016-2054	760,000	0	760,000
		TOTAL	800,000 Gallons that will not spill into adjacent Rattlesnake Creek and Don Pedro Reservoir.
Comments: With the upgrade, it is assumed that LS#16 will perform similarly to the other stations in the District. This assumption and the current storage capacity of LS#16 is the basis for the assumptions in this table.			

Table 9 – Annual Project Physical Benefits

Project Name: Groveland Community Services District GCSD/BOF (LS#16) Water Quality Protection Project (T-S IRWM Project No. 27)

Type of Benefit Claimed: Energy Cost Savings per Year

Measure of Benefit Claimed (Name of Units): Cost per Year

Additional Information About this Measure: Cost savings is based on the cost savings realized by these prior replacements provided District staff with an estimate for possible savings at Lift Station #16

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Cost per Year	Cost per Year	Change Resulting from Project (b) – (c)
2014	$3600	$2400	$1200
2015	$3600	$2400	$1200
2016-2054	$136,800	$91,200	$45,600
		TOTAL	$48,000.00 cost savings with implementation of project.
Comments: This table displays the physical benefits described in Energy and Power Cost Savings.			

References

HDR Engineering. 2013. Initial Study Report, Don Pedro Project, FERC No. 2299. http://www.donpedro-relicensing.com/Documents/P-2299_Don%20Pedro_InitialStdyRept_130117.pdf

Turlock Irrigation District and Modesto Irrigation District. 2011. 2010 Visitor Information Report . http://www.donpedro-relicensing.com